DOES THE USE OF ONLINE CURRICULUM CONTENT ENHANCE MOTIVATION, ENGAGEMENT AND LEARNING?

THE LE@RNING FEDERATION TRIAL REVIEW

PROFESSOR PETER FREEBODY

MAY 2005

Contents

ACKNOWLEDGEMENTS

Author
Professor Peter Freebody, University of Queensland

Acknowledgements
Some of the data collection and analysis reported in this paper was conducted by Mr David McRae and Mr Sandy Muspratt.

The participation of principals, teachers, parents and students from the schools involved in the research was very much appreciated. Thanks also to The Learning Federation Contact Liaison Officers who supported the research team in accessing data and information that was essential to the quantitative and qualitative analysis undertaken within the study.

1
EXECUTIVE SUMMARY

1. The *purposes* of this paper are:

   1.1. to summarise the available research literature on the efficacy of the use of Information and Communication Technology (ICT[s]) and online curriculum content generally

   1.2. to summarise a Pilot Field Review of an implementation of The Learning Federation (TLF) online curriculum content developed to date

   1.3. to draw conclusions concerning the maintenance of this implementation, including the direction of resources to professional development and longitudinal, recursively-designed evaluations of efficacy.

2. *Review* of available research literature

   2.1. A selection of Australian and international research studies, reviews of research and meta-analyses is summarised.

   2.2. A number of general conclusions are drawn:

   - There is very little research directly bearing on the use of online curriculum content in schools.
   - Research does not tell a consistent story about the efficacy of general ICT uses in schools.
   - Much of the reliable support for the use of online curriculum content in schools is indirect, coming from meta-analyses of instructional conditions, and studies of general ICT and digital material use.
   - The research area is characterised by very few large- or medium-scaled field experiments and relatively more small-scaled observation or interview studies.

3. Summary report of The Le@rning Federation's *Pilot Field Review*

   3.1. Case studies of six different schools, and surveys of about 500 teachers and 1600 students.

   3.2. Summary of findings

      3.2.1. The positive case:

      A strong *prima facie* case is established, from direct observation, interview and extensive surveying, that:

      - The use of TLF online curriculum content is in general supported enthusiastically by teachers, parent home-tutors and students.
      - The use of TLF online curriculum content motivates students to attend to and engage with tasks.
      - The use of TLF online curriculum content enhances students' learning and interest in learning across a range of tasks.

      3.2.2. Cautions

      There is in addition *prima facie* evidence that the following cautions or difficulties are relevant:

- Teachers need considerable time to ensure that their selection of learning objects, from an increasingly wide range, is appropriate to their needs.
- Technical difficulties present ongoing frustrations to teachers and increasingly complex and consequential challenges to systems.

4. Prospects for increased, better-targeted implementation: Research and professional development

4.1. The case and survey studies strongly suggest that the following hypotheses are important for a deeper understanding of the efficacy of the use of online learning objects:

- The TLF online curriculum content operates more effectively in some task domains and for some learning purposes than in others; further, these domains and purposes are not equally distributed across curriculum subject areas.
- There are significant differences in the nature and possibly the efficacy of usage between primary and secondary level classrooms, possibly relating to the relative modularity versus sequentiality of primary versus secondary classrooms respectively.
- The design of ICT work-stations in relation to the main classroom relates to the nature and possibly the efficacy of usage.
- When, where, how, and on whose say-so students get access to TLF online curriculum content affects the nature and possibly the efficacy of usage.

2
INTRODUCTION

1. The purposes of this paper are to provide background material related to the use of online curriculum content and, in that context, to report the outcomes of The Le@rning Federation's (TLF) Field Review of early implementations of the newly developed learning objects. Specifically, the following sections of this paper:

   i. summarise the available research literature on the efficacy of the use of ICTs and online curriculum content generally

   ii. summarise a Pilot Field Review of an implementation of TLF online curriculum content developed to date

   iii. draw conclusions concerning the maintenance of this implementation, including the direction of resources to professional development and longitudinal, recursively-designed evaluations of efficacy.

2. The Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) established The Le@rning Federation in 2001 to produce online curriculum materials and make them available to education systems in the states and territories of Australia and New Zealand. More specifically, TLF was charged with:

   i. Producing a repository of online materials in the following priority curriculum areas:

      - Innovation, Enterprise and Creativity (P-10)
      - Languages other than English (specifically Chinese, Japanese and Indonesian across all school year levels)
      - Literacy for students at risk of not achieving National Literacy Benchmarks (P-10)
      - Numeracy and Mathematics (P-10)
      - Science (school years P-6 and 9-10)
      - Studies in Australia (P-10).

   ii. Developing online materials that:

      - represent cutting-edge best educational theory and practice
      - engage teachers and students in active learning and in creative and critical thinking.

   iii. Supporting and reinforcing the increasing priority given to innovation, enterprise and knowledge by governments in Australia and New Zealand

   iv. Supporting teachers in developing enterprising education

   v. Engaging students in innovative learning environments

   vi. Equipping students to live competently and proactively in an environment increasingly characterised by online communication, learning and work

   vii. Stimulating the growth of a marketplace for quality public and private online curriculum content.

3. The term ‘online curriculum content’, as it is used here, refers to interactive learning activities (which may include texts, and/or graphic, audio or animated materials) that a) are linked to motivational and learning outcomes, and, b) capitalise in innovative ways on the particular potential of information and communications technologies to enhance young people’s learning. In this project, the online curriculum content takes the form of learning objects. These learning objects are:
    i. one or more files or modules of learning material
    ii. reusable in multiple settings and for multiple purposes
    iii. potentially usable in classrooms as components of units of work accompanied by digital and non-digital materials
    iv. accessible from digital repositories, as referenced, located and accessed by metadata descriptors.

3
THE AVAILABLE RESEARCH

1. Preview

The general question addressed in this review is: *what is the evidence from Australia and elsewhere for the positive motivational and learning effects of engagement in online curriculum content?* In summary, since there is very little research that can be brought to bear directly on this question, studies summarised below provide close, but in the end indirect evidence. The review leads to the conclusion that many studies have yielded either ambiguous or simply unimpressive findings:

> [In UK] the role and nature of ICT in schools is problematic, with minimal involvement of ICT across the curriculum in the everyday teaching of pupils … Rarely in the history of education has so much been spent by so many for so long, with so little to show for the blood, sweat and tears expended. (Nichol & Watson, 2003: 132-3)

It is clear that the introduction of contemporary technologies into classrooms has not, instantly and of itself, brought about the kinds of learning changes that some commentators had claimed were urgently needed in the new economies and the new forms of citizenship (eg, CEO Forum, 2000). What seems critical, and what seems to be the message from much of the "disappointed" research of the last 10 years relating to information technologies in education as exemplified by Nichol and Watson's comment above, is that the need is for more direct *curricular* consideration of ICT uses – that is, consideration of the curricular nature of the content and the ways in which the ICT uses can be located within modules and sequences of learning work.

But in spite of this, there is much research that has led to more encouraging conclusions than those of Nichol and Watson. It is reviews and meta-analyses of this body of research that form the body of the summary reported in this section.

2. A selection of research

2.1 Marzano (1998; and see Marzano, Gaddy & Dean, 2000) conducted a meta-analysis of over 100 research programs that incorporate several thousand experimental comparisons. Marzano and others set out to draw together field experiments that demonstrated positive relationships between instructional variables and students' learning. Using the criterion of an experimental effect size[1] of greater than or equal to 1 (ie, strong advantage for the intervention groups), Marzano found that the meta-analysis of effective instructional techniques and conditions showed the following to be important:

- the explicit teaching of new knowledge accompanied by the students' application of that knowledge in a variety of conditions
- the regular and systematic testing of hypotheses about new knowledge
- the representation of new knowledge in multiple modalities (linguistic, graphic, visual, auditory, etc)
- the use of computer-based, interactive activities to explore, discover and apply new knowledge.

Taken as a set, these demonstrably beneficial features of learning settings suggest (but do not clinch) the value of ICTs in classrooms. The findings draw attention to ICTs'

capacity to support teachers' explications of knowledge, and their unique potential for high levels of multimodal representation and interactivity, and as platforms for active information searching, collecting and synthesis. The significance of the first point for our purposes in this review is that the new knowledge can be explicitly presented in a learning objects (LO) environment, with immediate feedback, and with the potential for reusability in a variety of related curricular settings.

2.2 The British Educational Communicational and Technology Agency (BECTA) (2005) has conducted a review of research evidence related to the progress of ICT usage in educational settings. One of its conclusions is that purpose-built online content is the most productive developmental line for school applications. The authors point to a trend toward better supply of content for schools, even though the core curricular subjects appear to be best served in terms of the number of available resources. With respect to outcomes, the BECTA report notes a review by Cox and others (2003) indicating that:

> high-quality, interactive learning resources are more likely to be related to higher learning gains for pupils than other resources. The reviews point to substantial evidence of the impact of specific uses, for example, using simulations and modelling in Science and Mathematics. However, impact is dependent on teachers' use and quality of implementation. (p. 19)

However, the BECTA report also draws attention to the urgent need for increased, better-targeted, carefully designed and longer-term research in this area:

> On the basis of current data it is difficult to assess the quality of existing educational content and there is a need for a more sophisticated analysis of the dimensions of quality in practice. (p 4)

For purposes of this review, the BECTA documents provide among the most coherent and carefully quality-assured bodies of evidence, at least within the UK setting.

2.3. A number of reports of individual research projects indicate aspects of positive ICT effects. Mann, Shakeshaft, Becker and Kottkamp (1999), for instance, concluded general ICT usage has positive effects on basic learning over 10 years' implementation in a statewide educational jurisdiction. They concluded that ICT advantages were particularly pronounced in the case of curricular tasks that are traditionally regarded as very difficult to teach and with which students generally have learning difficulties.

Similarly, Passey, Rogers, Machell, and McHugh (2004) reported on 17 case studies, 293 interviews with principals, teachers, pupils, parents, social workers and teacher aides, and 1206 pupil surveys on attitudes to learning. Their key findings (page 3) were:

- ICT use by pupils and teachers in the case study schools led to positive motivational outcomes, supporting a focus upon learning and the tackling of learning tasks.
- Positive motivational outcomes were most frequently found when ICT was used to support engagement, research, writing and editing, and presentation of work. Where ICT uses supported internal cognitive aspects of learning, for example in the case of secondary design and technology, there were indicators that the motivation arising from the use of ICT was linked to enhancements in some subject-specific learning gains.
- There were indications that ICT positively affected pupil behaviour both inside and outside school.

Among the areas of pupil motivation positively affected by ICT, the researchers cited:

- attitudes towards school work

- perception of class time as more interesting
- homework
- pupil confidence
- increased independence among learners
- improved behaviour in the classroom.

3. **Summary**

3.1 To summarise this brief review of the research literature, there is now a reasonably well-established body of empirical work on the nature and efficacy of ICT use in school classrooms, and much of that is positive with regard to the motivational and learning outcomes of ICT use generally.

3.2 This literature nonetheless provides relatively little reliable guidance on conclusions relating to medium- or long-term effects of ICT use, less on the specific motivational and learning outcomes of specific kinds of ICT use in classrooms, and even less still on the consequences of the use of ICT-based online curriculum content. As a field of research, it is also the case that the general area is characterised by very few large- or medium-scaled field experiments and relatively more small-scaled observation or interview studies.

3.3 At this point in the evolution of research and theorising educational technology use, it seems that TLF's provision of online curriculum content across a range of both curriculum areas and systems represents a potentially new level of implementation and thus a green field for research and evaluation.

4
EVIDENCE FROM THE LE@RNING FEDERATION'S FIELD REVIEW

1. The structure of the Field Review

There are two components to the TLF Field Review: case studies of six very different schools, and surveys of teachers and students. The focus at all times was on the initial establishment of the efficacy of the online materials in enhancing students' motivation and learning.

1.1 *The case studies*

As Table 1 indicates, teachers, school leaders, students, and, in one case, parent-tutors participating in the case studies were chosen to represent a broad range of setting, demands, and clienteles. Rather than structure the sample in terms of proportional survey representativeness, the goal was more to get a glimpse of the range of sites in which the learning objects were put to work, to maximise the view of the variety of things that could go right or wrong.

Table 1: Summary description of participants and observations in the case studies component of the Field Review

School	Nature	Year-level/s observed	Curriculum area/s of lessons observed	Learning object/s used[2]
Boggabilla Central School, NSW	Small rural, K-12 school, with all-Aboriginal student population.	5+6 multi-aged, mixed but generally low academic ability level	Numeracy / Mathematics	5 objects in use, all related to fractions and percentages.
Cairns School of Distance Education, Qld	Support for 485 years 1-11 students in rural, remote, home-schooling, travelling, medical, school-refusers, or overseas resident settings. Input from parent home-tutors.	Telephone discussions only with parents and students.	All areas.	Wide range of available Objects.
Geilston Bay HS, Tas.	310 Years 7-10 students from mixed socio-economic backgrounds, largely low SES.	9, full range of academic abilities	SOSE	"Catch a thief" (Literacy catalogue).
Magill PS, SA.	560 Years 3-7 students, 55 nationalities of origin/parentage, mid-high SES.	5, full range of academic abilities	SOSE	"Underwater discovery" (Literacy catalogue).
Melrose HS, ACT	820 Years 7-10 students, middle SES,	10, high academic achievement	Science / Physics	"Give it a brake" (Science catalogue)
Tongala PS, Vic.	250 P-6 students, rural, low SES.	3-6 multi-year class, with full range of academic abilities	Numeracy / Mathematics	"Wishball" (Numeracy catalogue)

1.2 *Surveys*

1.2.1 The survey was administered electronically, though use of SurveyMonkey software. TLF associates in each state and territory provided teachers and students in participating schools with the survey URLs and encouraged them to respond. Separate surveys were designed for teachers and students (see Appendices 1 and 2). Some responses were retained from a pilot administration in late 2004, and the final version was sent for online response in early 2005. Items from both are included at various places in the analysis to maximise response rates to key questions.

1.2.2 The main questions concerned respondents' overall judgements about the motivational and instructional efficacy of the online curriculum content used in the school site, along with a set of questions relating to the demographic background of the respondent and the school site. Further, more specific questions related to the use of TLF online curriculum content. Teachers were asked to rate the helpfulness of the TLF online curriculum content in supporting teaching and learning, and whether or not the TLF online curriculum content improved students':

- motivation
- persistence
- depth of learning
- higher-order concepts
- collaboration with peers
- independence in learning.

Students were asked whether or not the TLF online curriculum content was:

- interesting and fun
- easy to work with
- helpful in thinking about new ideas
- best when student worked with a partner
- such that the student needed a lot of help from his or her teacher.

Students were also asked about the helpfulness of various characteristics of the learning objects, including:

- sound
- animation
- interactivity
- self-paced
- repetition until successful
- reception of feedback
- clear instructions for improvement.

1.2.3 A total of 500 teachers and 1681 students completed the surveys. The breakdown of responses by state and territory are shown in Table 2.

Table 2: Breakdown of teacher and student responses by state and territory

Jurisdiction	Number of teachers	Number of students
Australian Capital Territory	33	65
New South Wales	42	338
Northern Territory	19	25
Queensland	243	214
South Australia	57	199
Tasmania	15	154
Victoria	64	678
Western Australia	27	8
TOTAL	**500**	**1681**

Some further features of the sample are:

1. Of the teachers, 71% were female and 29% male; among students, 53% were female and 47% male.
2. Of teachers, 66% were located in urban sites; 26% rural; 6% remote; and 3% by distance education.
3. 57% of students were located in urban sites; 37% rural; 6% remote; and n=2 student respondents were studying by distance education.
4. 79% of schools were government schools.
5. 95% of schools were co-educational.

2. Converging findings

This section reports the major findings of the Field Trials. An overall feature of these findings is their consistency. Patterns established in the survey results were directly replicated, with local variations, in the case study reports. Consequently, these are reported in an interleaved manner in the discussion that follows.

2.1 A strong *prima facie* case is established, from direct observation, interview and surveying, that the use of TLF online curriculum content:

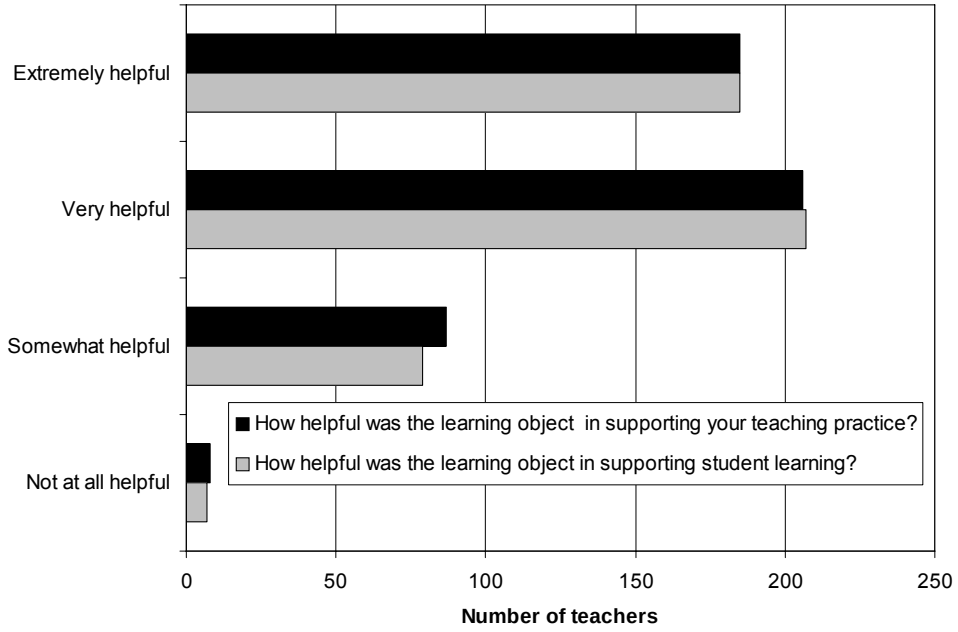
1. is generally supported by teachers, students and parent home-tutors
2. more specifically, motivates students to attend to and engage with tasks
3. enhances students' learning and interest in learning across a range of tasks.

2.2 To support each of these conclusions, the following section summarises the relevant survey responses and then provides a collection of direct quotes from teachers and parent home-tutors who participated in the case studies.

Conclusion 1: *The use of TLF online curriculum content is in general supported enthusiastically by teachers, parent home-tutors and students.*

Figure 1 shows the response rates to the questions put to the teachers about the value of the learning objects they had been using. It can be seen that highly positive responses were by far the most common, with 'extreme' support expressed by about 40% of teachers.

Figure 1: Response rates to general questions of support for TLF online curriculum content by teachers.



In response to the general question: *Do you think using this learning object is a good idea?* 88% of students said *yes*, 12% *no*.

A sample of comments from teachers and parent home-tutors on 'general support' follows.

> *The best things about using the objects? Just a summary of what I've said really — you can simulate things you can't do otherwise, you can sometimes get difficult concepts across more easily, it expands the range of teaching and learning activities, and variety is important. But number one is: it's fun.* (Teacher, Melrose HS case study)
>
> *My boys* [Year 4 and Year 7] *have absolutely loved using them. They love every part of it. It has improved their interest in computers and their skills in using them. They can work on their own, and they have such a good time! Anything that helps their learning I'm in favour of, but the learning objects have made such a difference.* Parent home-tutor A, Cairns SDE case study [insert added])
>
> *I saw them and I was desperate to try them in the classroom immediately. I thought the kids are going to love this. They are so multi-dimensional. They will be excellent for engagement and also for reinforcing what we are doing elsewhere. They're too good not to use. Initially I thought, 'I'm not very good at this … oh well, I suppose the kids will be' and we worked it out together. I have been watching their confidence just flourish. They love using them.* (Teacher, Tongala PS case study)
>
> *We're just so grateful for what this has done for our kids.* (Parent home-tutor B, Cairns SDE case study)

In some cases, participants reported that the use of the TLF online curriculum content actually changed the learning and studying attitude of students in a radical and durable way. While the significance of the cautions discussed below should not be under-estimated, it is clear that teachers and parent home-tutors expressed a keen sense of the dramatic potential of the use of TLF online curriculum content for their

students/children. Impediments and difficulties were nowhere taken to be problematic enough to stand in the way of the development and implementation of the LO initiative.

The comments collected above are a representative sample of high levels of general support for the learning objects' use. They are uniformly strong throughout the sample of respondents (including the survey respondents). We cannot locate in the survey responses, or the quotes from teachers or parent home-tutors, or the field notes of the observers a single general negative evaluation of the trial programs.

Conclusion 2: *The use of TLF online curriculum content motivates students to attend to and engage with tasks.*

Figure 2 shows the mean response rates to the questions put to the teachers about the value of the learning objects they had been using for students' motivation and persistence. It can be seen that responses are in general highly positive.

Figure 2: Teachers' ratings of the impact of learning objects on students' motivation and persistence with tasks

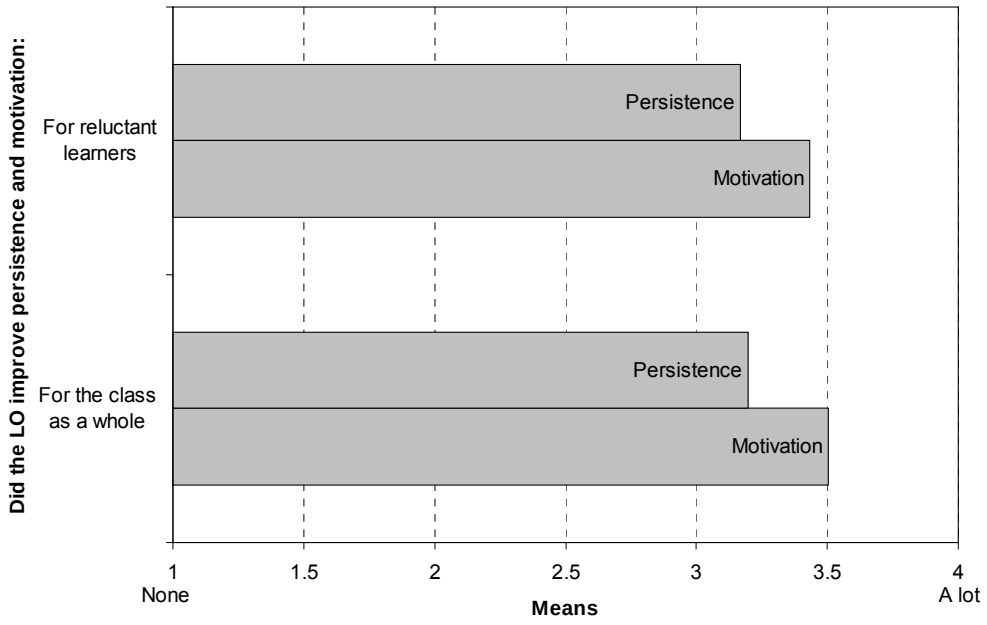


Figure 3 shows the mean response rates to the questions put to the students about the learning objects in general. It can be seen that, on the whole, responses were positive and that students were not reliant on teachers' help in working through a LO.

Figure 3: Students' ratings of the learning objects in general

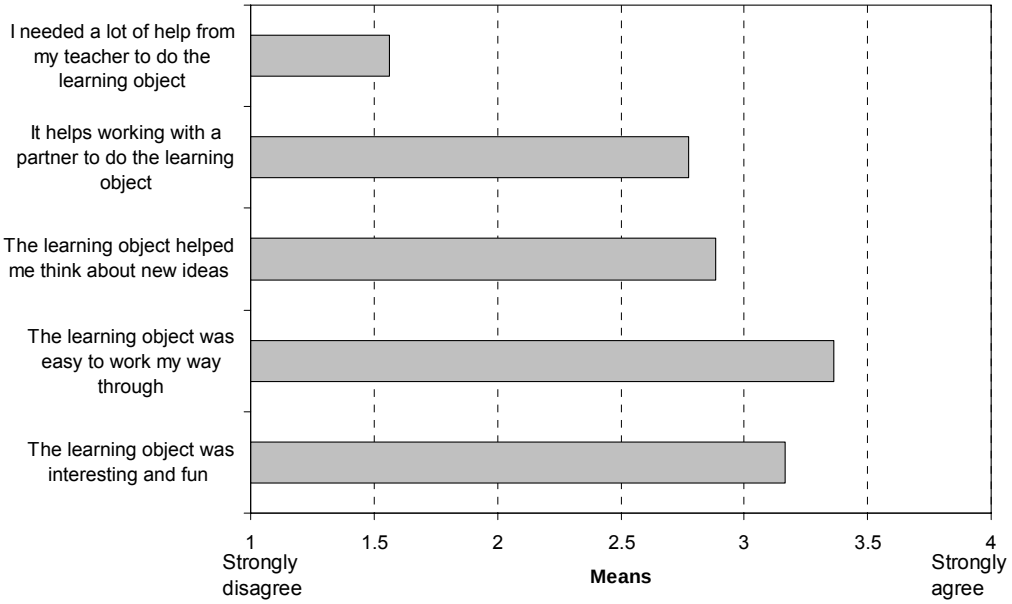
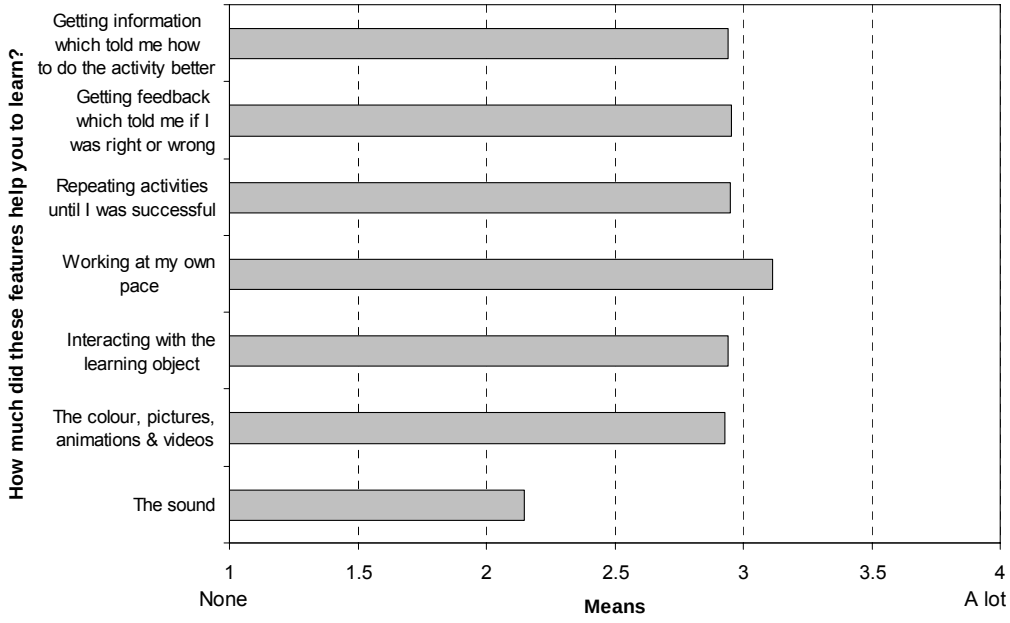


Figure 4 shows the mean response rates to the questions put to the students about the influence of features of the learning objects on their learning. With the exception of "sound", students on the whole agreed that features of the learning objects helped them to learn. There is some evidence among the teachers' comments that sound was turned off or was not available, and this may be the reason why students' rating for "sound" was lower.

Figure 4: Students' ratings of the impact of features of learning objects on their learning



A sample of comments from teachers and parent home-tutors on motivation and engagement effects follows.

> *I had a look at a few* [objects], *"Give me a brake", "Where does speeding get you?" and one or two others, all Physics-based actually; and I knew they'd go down well and the kids would love them because I enjoyed playing with them so*

much. That's a reasonable test I think. I'm very conscious of things that I think are too simple. (Teacher, Melrose HS case study)

The best thing about the learning objects is that kids get so engaged when they use them. (Teacher, Tongala PS case study)

They don't think it's school work, but they're still learning at the same time. At night, or next day, he'll start talking about something that he's learnt. I'm sure the recall is far better. When he is reading normally he could be up in space. He's just not taking it in. But now he goes 'Mum!' and reels off fact after fact. (Parent home-tutor A, Cairns SDE case study)

It's given Ashleigh a real boost. I don't have to be on top of him to get him doing his school work all the time. (Parent home-tutor A, Cairns SDE case study)

We really look for the learning objects. What it means for me is that I can just walk off and leave them to it and know they're learning. (Parent home-tutor B, Cairns SDE case study)

I like the fact that a lot of them are self-correcting. The kids can work independently and aren't calling out to you for help all the time. They call out, but it's to show you what they've done, and that's a very different thing. (Parent home-tutor A, Cairns SDE case study)

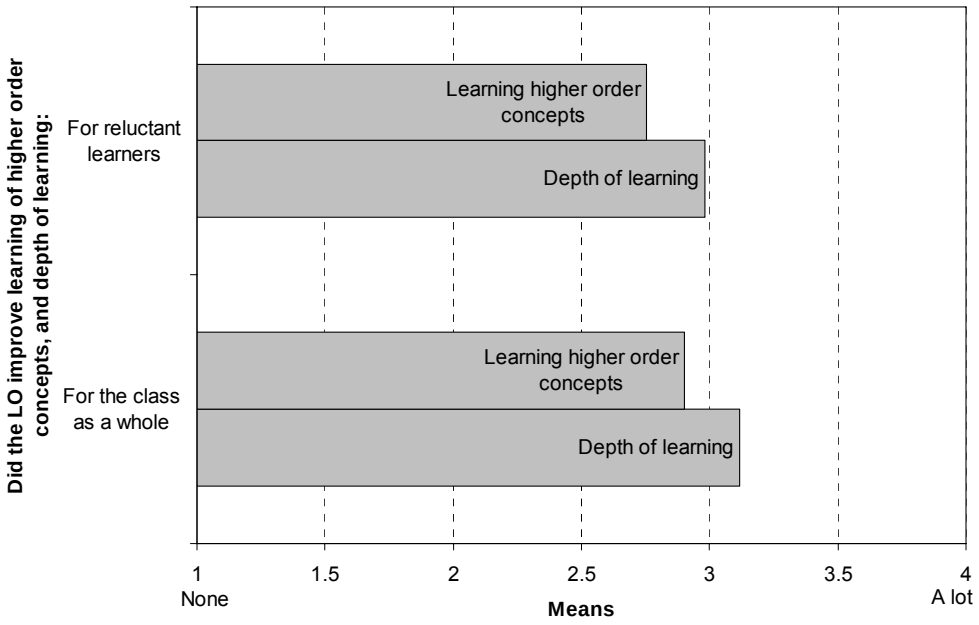
People want to take control of their own learning, and this sort of learning can provide that control to a very high degree. This is obvious with the kids. They love it. They're in charge. (Teacher, Magill PS case study)

Clearly participants generally regarded motivation as a critical benefit of the use of the online materials. Motivational effects are variously characterised by the participants as relating to students' control over the selection and pacing of the learning environment, the capacity of the TLF online curriculum content to provide feedback and self-correction, enjoyment and independence. As with the conclusion above, these views were widespread in the sample, and often expressed with considerable enthusiasm.

Conclusion 3: *The use of TLF online curriculum content enhances students' learning across a range of tasks.*

Figure 5 shows the mean response rates to the questions put to the teachers about the value of the learning objects they had been using for students' learning. It can be seen that responses were highly positive.

Figure 5: Teachers' ratings of the impact of learning objects on students' learning of higher order concepts, and their depth of learning



A sample of comments from teachers and parent home-tutors on motivation and engagement effects follows.

> *It was during the use of this object that one female student provided the clearest evidence to date of direct learning as a result of her experience of using the object. She began by asking what percentages were and clearly didn't know. About ten minutes later she was not only showing that she could use this notion to work on the object but actually said, 'Percentages are parts of a hundred. So if it's 50 parts it's half of the whole lot.'* (Boggabilla CS case study field notes)
>
> *Using the objects is just another teaching tool. Some of them like [Learning Object] Where does speeding get you? have very valuable functions. It's about scalar and vector qualities and as a rule they're very difficult concepts to get across. But in this case they can actually see the car travelling, see the impact of the speeding. It makes it so much easier to teach.* (Teacher, Melrose HS case study)
>
> *They help you teach things that are hard to teach in other ways. The abacus and the number line in* Wishball *for example are very effective scaffolds to support the development of strategies to generate understanding of place value.* (Teacher, Tongala PS case study)
>
> *They give all the facts, and they're very easy to follow. You can do the science experiments without all the set-up which we can't often really achieve, and you feel like you're working at a much higher level.* (Parent home-tutor B, Cairns SDE case study)
>
> *We are working on an assignment related to amber light timing. You need to work out how to stop safely and so on. And this had to be a simulation and the object that supported that [the one used in the case study class] was very effective. The simulation function is very useful in Science with issues like safety, and expensive and complicated equipment and things you simply can't do apart from simulations. In practical work you try to make things as authentic as possible and often simulation is the best way to do that.* (Teacher, Melrose HS case study)

They help in other ways as well. We were doing work on Chance and Data, an area I'm not especially strong on, and we were using 'The slushy sludger' [an object which requires users to estimate the chances of producing a particular form of drink from a set of sources] *and I realised very quickly that they weren't as advanced as I thought they were. It was a very efficient way of doing that.* (Teacher, Tongala PS case study)

Another of the things I appreciate is the choices that are available in the set-up of an object. For example, the possibility of using sound and getting the object to 'talk' to you is very valuable with younger kids. I find that the recommendations for Year level use are not nearly as flexible as actual use indicates. You can use all sorts of objects with all sorts of kids depending on your purpose. You might want to go back over something for reinforcement or to provide younger students something with a bit more challenge and they'll be up for it. I find the objects are all very different, so you can use them for many different purposes — introduction, reinforcement, extension — and you adjust, for example, for theme, level and place in a unit. (Teacher, Tongala PS case study)

You can see how beautifully these media fit with our requirements and the learning objects as well. You have spoken/audio help for students with low academic skills, there are dozens of learning and teaching tools that kids can get access to. We just looked at them and said, "Oh wow. These are going to work so well with the kids". (Teacher A, Cairns SDE)

The objects are so good at facilitating learning how to learn. You are often required to take on a role and become part of the game, you know, the author of the story. (Teacher B, Cairns SDE case study)

Learning objects can only make life better for the kids we teach. The only real problem we've got is that there are not enough. We can't wait for our next instalment. (Teacher A, Cairns SDE case study)

3. Students with special needs

The participants regularly drew attention to the value of the online learning objects especially when the material is traditionally hard to teach, as noted above, and when the students themselves are conventionally regarded as hard to teach. In that respect, it is important to note the particular beneficial effects of this approach to learning for Indigenous students and students with disabilities, as in the comments below.

The kids all enjoy them. They are very engaging. The use of computers in itself is a novelty in a way it might not be for many other kids. The visual element is very powerful, and it's more of a game rather than what they sometimes think of as learning. You can have too much of sitting down and working with paper and pens in a classroom. It helps to break that up, and to increase the range of activities. The independent way of working is valued, and I never have to keep them on task when they are on the computers. The audio aspect of some of the objects [clicking a button to produce instructions in audio form] *is especially good, because some of our kids have low reading levels.* (Teacher, Boggabilla CS case study)

We have quite a lot of kids with severe learning problems. I find that they have a better chance of interacting and achieving through using the objects. They like being able to make choices and work on their own. It's not just that they have learning problems. It's the particular nature of their problems we have to accommodate. This is often about being shy and dysfunctional in mainstream

situations. To be able to offer this sort of support is just great. (Teacher A, Cairns SDE case study)

4. Summary

To summarise, participants consistently reported improved learning outcomes from engagement in the online learning objects. That improvement for this sample of teachers and parent home tutors was related variously to:

- support for teaching difficult concepts
- presentation of knowledge in multiple modalities
- flexibility of access and use
- the enhanced teaching and learning repertoire afforded by the setting
- independence of learning.

4.1 There is in addition *prima facie* evidence that the following cautions or difficulties are relevant:

1. Teachers need considerable time to ensure that their selection of learning objects, from an increasingly wide range, is appropriate to their needs.

   The other issue is time, 'exploration' time. To use the learning objects effectively you have to have time to look through them properly. They all have their own distinctive features that you have to be aware of. (Teacher, Boggabilla CS case study)

2. Technical difficulties present ongoing frustrations to teachers and increasingly complex and consequential challenges to systems.

   It's so frustrating. You have a great lesson, it's all organised, and then something happens and you have to adapt and start again. It's very annoying. (Teacher, Boggabilla CS case study)

It is important to point out, however, that in all observations, interviews and survey setting, the number of positive features and the intensity of the support for the initiative heavily outweighed cautions and negatives by a large margin. The Appendices bear this out with respect to field notes from the observations and the interview materials.

5
FURTHER IMPLEMENTATION, RESEARCH AND EVALUATION

1. Preliminary analyses also suggest that pursuing the following issues will be important for a deeper understanding of the efficacy of the use of online learning objects. These issues are developed in light of preliminary statistical analyses of the survey data, in particular the closer analysis of variables that relate to the key outcome measures, motivation and learning effects. Results of these preliminary analyses (including Principal Component Analyses of the dependent variables dealing with improvements in student learning, Cluster Analysis of linguistic and demographic groupings of students, and Multivariate Analyses of Variance [MANOVA] that relate the dependent variables to differences across curriculum area, grade level) are shown in Appendices 9-13. Each of these issues is briefly discussed in the sections below.

   i. The TLF online curriculum content may operate more effectively in some task domains and for some learning purposes than in others; further, these domains and purposes are not equally distributed across curriculum subject areas. As illustrated in Figures 6 and 7, teachers' ratings of the helpfulness and motivational effects of the learning objects were positive, but nevertheless there are differences in overall rated helpfulness for teaching and learning and motivation relating to curriculum subject area. (Appendix 11 contains the results of MANOVAs that show a statistically significant relationship between curriculum area and rated helpfulness for teaching and learning, and a potential significant relationship between curriculum subject area and degrees of support for LO use in the class as a whole and for reluctant learners.)

Figure 6: Ratings of 'helpfulness' by teachers from different curriculum subject areas.

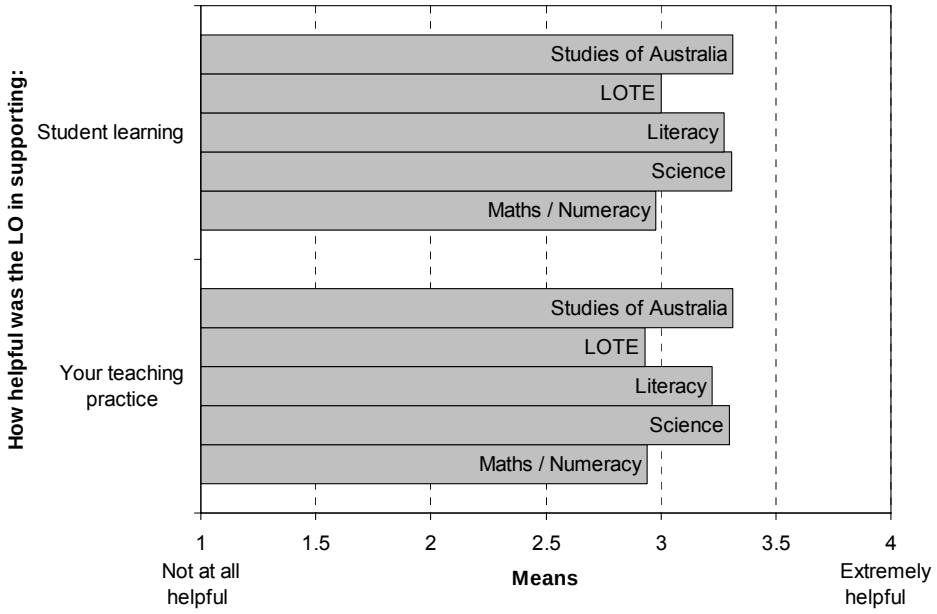
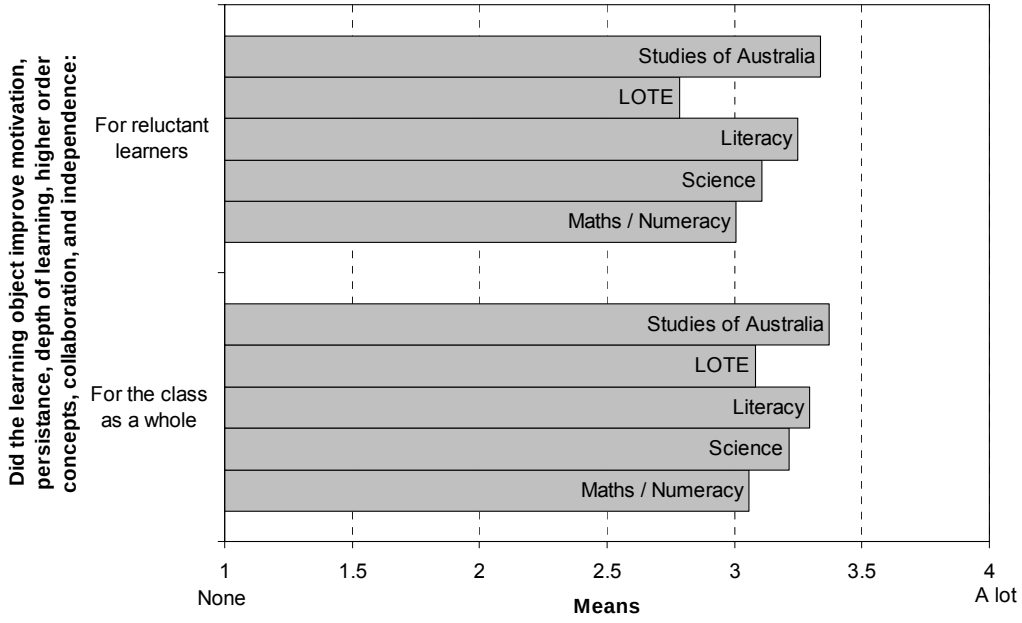


Figure 7: Ratings of motivational effects of engagement in online curriculum content by teachers from different curriculum subject areas.



2. A difference in the efficacy of the TLF online curriculum content depending on curriculum subject area is plausible from a number of perspectives. For instance, cognitive scientists and instructional psychologists such as Jonassen (1997) have drawn the important distinction between well-structured and ill-structured ('open-ended') problems and knowledge domains: well-structured problems are those that are constrained, with convergent solutions that engage the application of a limited number of rules and principles, and with well-defined parameters, right answers and right ways to doing them; ill-structured problems entail potentially multiple solutions and solution pathways, fewer set parameters that are less manipulatable, and uncertainties about which concepts, rules, sequences, and principles may be necessary for the solution, how these issues may be organised, and which solution is best for the particular task at hand.

From this view we may expect that an approach based on online learning objects might work better in some task domains than others, and, further, that these task domains may be more prevalent in certain discipline or curriculum areas than others. There is some indirect support for this idea from researchers such as Mitchell and Savill-Smith (2004) and Muir (2001) who have found selective advantages for mathematics and science (especially physics) activities in online LO and educational gaming environments.

3. Perhaps because of possible selective curriculum area advantages, there may be an implicit selection bias in the teachers' selection of learning objects for classroom work; that is, teachers working in Key Learning Areas (KLAs) that are characterised by certain kinds of knowledge and performance demands will tend to favour adoption and thereby constrain the generalisability of voluntary trial studies.

4. There is a second issue that requires further research:

   ii. There are potentially important differences in the nature and possibly the efficacy of usage between primary and secondary level classrooms, possibly relating to the relative modularity of primary versus the stricter sequentiality of secondary classrooms. As shown in Figures 8 and 9 (helpfulness and motivation respectively), all levels of support are high for the positive effects on reluctant learners but the level of reported support across all variables is

higher for primary school respondents (although, as shown in Appendix 12, these relationships are not statistically significant in this sample of teachers).

Figure 8: Ratings of 'helpfulness' by teachers from primary and secondary classrooms.

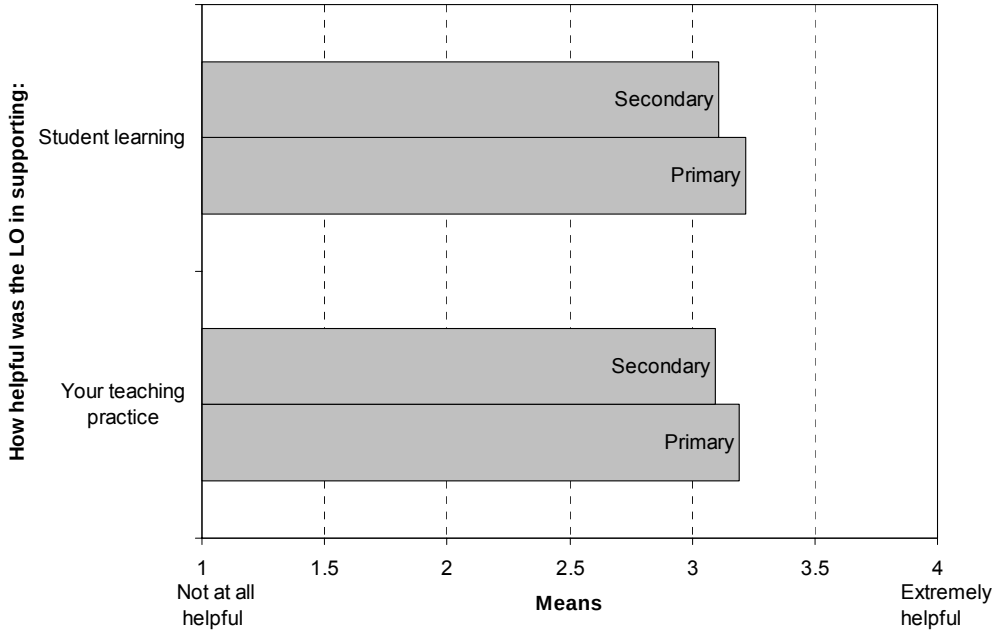
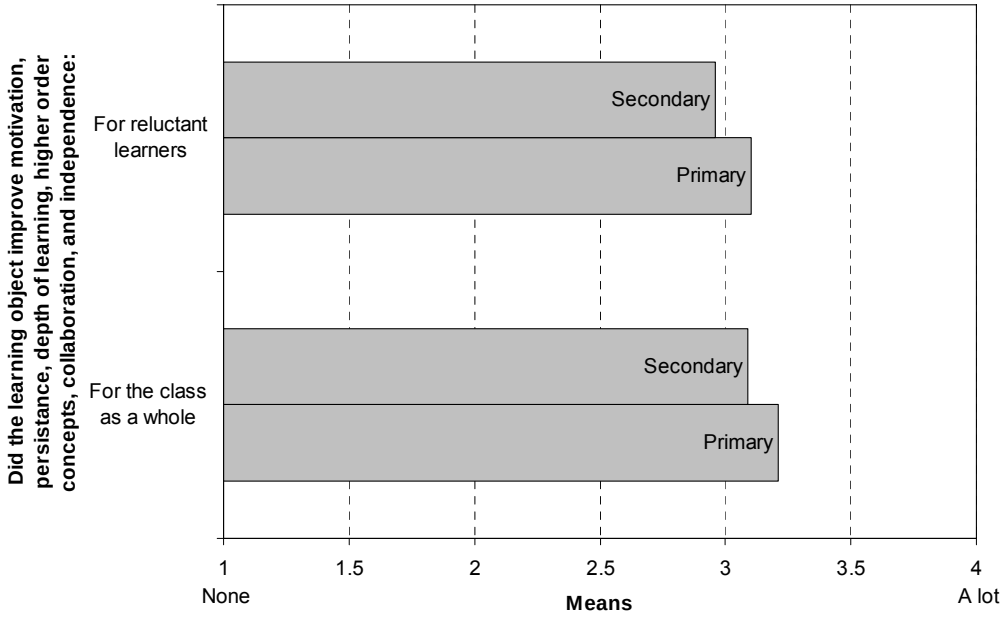


Figure 9: Ratings of motivational effects of engagement in online curriculum content by teachers from primary and secondary classrooms.



5. It is commonplace to point out that the school curriculum areas continue to become more distinct from one another in terms of the knowledge, processes, skills and learning dispositions they call upon and develop. In most Australian schools, primary educators plan and put in place learning activities that are more loosely integrated, free-ranging, and episodically sequenced than those of their colleagues teaching in the secondary school programs. Further, it is generally the case that students in primary classrooms work with one or two teachers only across the year, again, in contrast to secondary classrooms. These or other factors would lead to a hypothesis that

comparatively stand-alone, focused and 'random-sequenced' learning programs such as the online learning objects would need to be integrated into primary and secondary classroom work in qualitatively different ways, and perhaps with differing levels of motivational and learning outcomes.

6. A third important issue concerning the use of TLF online curriculum content in classrooms is as follows:

iii. The cultural, socio-economic and linguistic backgrounds of the students may have a substantial effect on the reported efficacy of the use of TLF online curriculum content. Appendix 13 contains the results of MANOVAs that indicate statistically significant relationships between cultural, socio-economic and linguistic cluster membership and: a) the helpfulness of the learning objects in supporting student learning and teaching practices; and b) degrees of support for LO use in the class as a whole and specifically for reluctant learners. These findings are illustrated in Figures 10 and 11.

Figure 10: Ratings of 'helpfulness' by teachers working with students from a variety of cultural, socio-economic and linguistic backgrounds.

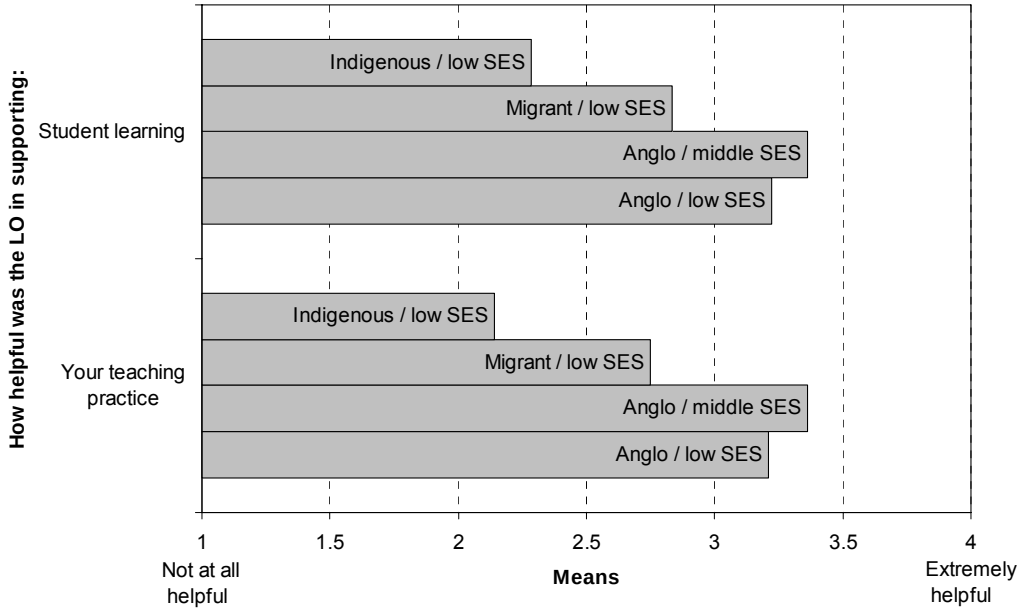
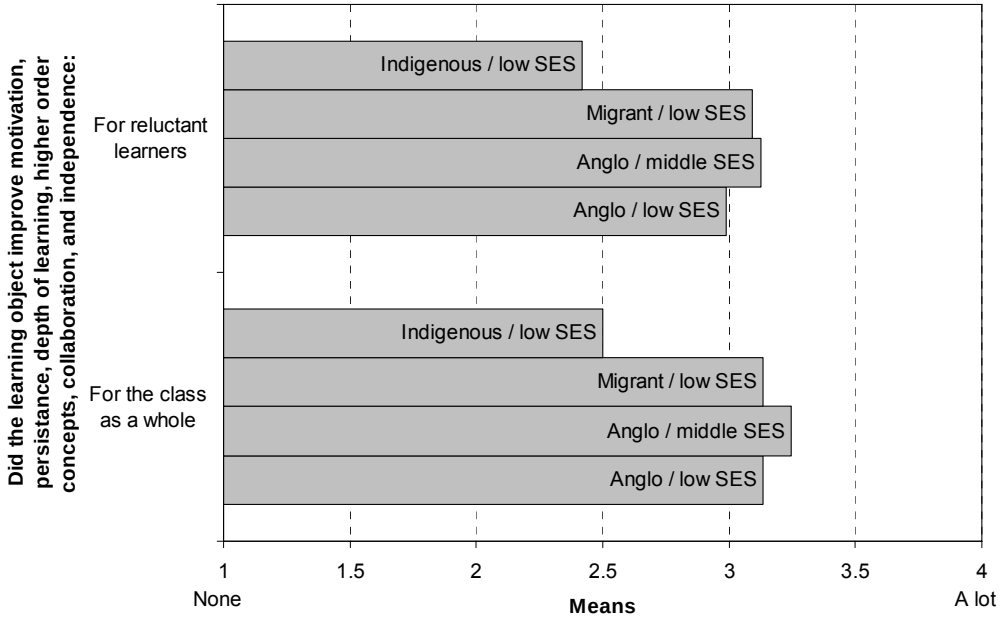


Figure 11: Ratings of motivational effects of engagement in online curriculum content by teachers working with students from a variety of cultural, socio-economic and linguistic backgrounds.



Young people operate, out of school, in a wide variety of complex communicational environments, reflecting to differing extents the rapidly evolving technological, cognitive and social demands of the workplaces and educational and training sites that await their departure from school (Mikulecky, & Kirkley, 1998; Thomas, Sammons, Mortimore, & Smees, 1997). These environments may be radically different from the 'native' communicational patterns of most of their teachers. While the consequences of online curriculum learning are not well documented, it seems clear that school work has the potential to extend students' abilities to combine multimodal learning and literacy activities, using a variety of technologies and in particular ways across varying disciplines, in ways that change the structures of how they learn, represent and communicate their new knowledge (Merchant, 2001; Tierney, 1996). However, what is equally clear from the research literature is that such benefits are by no means guaranteed, and that variation in the quality of the materials and the needs – in terms of cultural, linguistic and special ability-related needs – would be expected to have a crucial effect on motivational and learning outcomes.

7. An additional issue concerns the physical and logistic arrangements of the classroom and the place of the computer access:

iv. The design of ICT work-stations in relation to the main classroom may relate to the nature and possibly the efficacy of usage because it is related in turn to when, where, how, for how long, and on whose say-so students get access to learning objects.

Again, it is indirect rather than direct evidence that suggests a relationship between the layout of the classroom and efficacy if ICTs (Cox, *et al*, 2003; Lowther, Ross & Morrison, 2003). One of the strengths of the online LO approach noted by participants in the Pilot Field Review and as summarised above, is the flexibility of access. Some classes of students have strictly rostered access to 3-4 computers in the back of the room; some classes move in and out of lab-type facilities with varying degrees of freedom; and some need to rely on the personal policies of individual teachers for access. It is plausible to suggest that these factors bear significantly on the implementation and efficacy of TLF online curriculum content.

6
CONCLUSIONS

Schools' abilities to equip students with the kinds of knowledge, processes, skills and dispositions needed for improving their life and learning pathways will depend in part on how well learning experiences can be provided that acculturate students into rich and relevant appreciations of the nature and consequences of new communication technologies. There is now a body of research literature attesting to the economic and social implications of inadequate communicational skills. These skills – traditionally but no longer exclusively associated with conventional print-based technologies – have been shown to be critical for cultural cohesion, economic productivity, and for short- and long-term employment; failure has been directly associated with the acceleration of inter-generational exclusion and alienation (Brine, 2001; Bynner & Parsons, 2001). Rapidly growing digital and online communicational environments call for changes in both educational practice and the research and development programs that inform that practice.

The assumption that the development of ICT participation and capability can be adequately provided through traditional print-based school learning, or assessed by out-of-school, 'community' or popular-culture materials is now generally regarded as fanciful (Freebody, Hedberg & Guo, 2004). However, much of the currently available research and rhetoric relating to ICT use in schools continues to fluctuate between utopian visions of the potential of digital learning and the disappointment of either ambiguous or 'disappointing' results. van Dam, Becker and Simpson (2004), for instance, concluded that the major reasons for the apparent lack of "dramatic improvement" in the demonstrated uses and efficacy of ICTs in educational settings are:

- inadequate investment in appropriate research and development of authoring tools and new forms of content
- inadequate investment in the creation of new, dynamic and interactive content that takes proper advantage of digital hypermedia and simulation capabilities (as opposed to repurposed print content) at all educational levels and across the spectrum of disciples
- inadequate investment in appropriate IT deployment in school (e.g., although PCs are available in K-12, there are too few of them, they are under-powered, and they have little content beyond tradition ' drill-and-kill' computer aided instruction or CAI; at the post-secondary level there is more availability of computers and software plus routine use of the Internet but still dearth of innovative content that leverages the power of the medium)
- inadequate support for teacher education in IT tools and techniques and for the incorporation of IT-based content into the curriculum.

Along with these considerations, however, is a growing body of research that acknowledges the complexity of the issues involved in changing classrooms into digital or at least digitally-informed learning spaces, but that nonetheless shows positive ways in which productive changes can be brought about (Lankshear, *et al*, 1997; Snyder, 2002; Snyder & Beavis, 2004). This is where the Pilot Field Review summarised here is important, because it provides clear and consistent support for the use of online curriculum content:

- The TLF online curriculum content is, in general, enthusiastically supported.
- Participants – teachers, parent home-tutors and students – consistently report that it motivates students to attend to and engage with tasks.
- Particpants also consistently report that it enhances students' learning and interest in learning across a range of tasks.

The force of the conclusions is multiplied by the uniformity of the patterns of response from all participants, converging almost perfectly across the different data sources in the Pilot Field Review. This convergence offers a resolutely optimistic platform for further implementation, as well as helpful pointers toward factors that might make a significant difference in the nature and efficacy of future implementations.

The task for research and development world-wide is to document – over the long term and in an ecologically valid range of educational settings – both the immediate and the sustained consequences of engagement with online curriculum content. It is also important that this research process be intimately and formally connected to materials improvement and classroom practice, through recursive cycles of implementation, feedback and refinement.

It is clear that TLF's initial products and implementations have been consistently successful, at least as assessed by clients' responses. Networking of interested and committed educators has productively begun around the online curriculum content; and an orientation to systematic empirical evaluation has been established. The Le@rning Federation and its collaborators in educational jurisdictions are in a prominent position to contribute significantly to the urgent research and development program called for by these new learning times.

NOTES

1. An effect size is a measure of 'practical significance' (as opposed to statistical significance, which indicates the reliability of differences). Effect size reflects the magnitude of an intervention compared to control conditions. An effect size of greater than or equal to 1, for example, indicates that the mean performance for participants in the intervention condition was better than about 80% of peers in the control condition, assuming the distribution of scores was approximately normal.

2. Refer to the Learning Objects Catalogue, TLF document, for descriptions of each target curriculum area.

REFERENCES

Brine, J. (2001). Education, social exclusion and the supranational state. *International Journal of Inclusive Education*, 5, 119-131.

British Educational Communicational and Technology Agency (BECTA) (2005). *Evidence on the progress of ICT in Education.* Coventry, UK: BECTA.

Bynner, J. & Parsons, S. (2001). Qualifications, basic skills and accelerating social exclusion. *J of Education and Work*, 14, 279-291.

CEO Forum on Education and Technology (2000). The Power of digital learning: Integrating digital content. *The CEO Forum School Technology and Readiness Report*, Year 3. http://www.ceoforum.org/downloads/report3.pdf

Cox, M., Abbott, C., Webb, M. Blakeley, B., Beauchamp, T. & Rhodes, V. (2003). *ICT and attainment: A review of the research literature*. ICT in Schools Research and Evaluation Series Number 17, BECTA/DIES, London. Available at www.becta.org.uk/page_documents/research/ict_attainment_summary.pdf

Freebody, P., Hedberg, J. & Guo, L. (2004). *Digital Curricular Literacies, Project 1: Classroom Interaction* (Background and Preliminary Findings). Research Report #04-010, Centre for Research in Pedagogy and Practice, National Institute of Eduation, Singapore.

Jonassen, D.H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational technology research and development*, 45, 65-95.

Lankshear, C., Bigum, C., Durrant, C., Green, B., Honan, E., Morgan, W., Murray, J., Snyder, I. & Wild, M. (1997). *Digital rhetorics: Literacies and technologies in education—current practices and future directions*. Funded by the Commonwealth Department of Employment, Education, Training and Youth Affairs (DEETYA), Children's Literacy National Projects Program. Canberra: DEETYA.

Lowther, D., Ross, S. & Morrison, G. (2003). When each one has one: the influences on teaching strategies and student achievement of using laptops in the classroom. *Education technology research and development*, 51, 23-44.

Mann, D., Shakeshaft, C., Becker, J. & Kottkamp, R. (1999). West Virginia story: Achievement gains from a statewide comprehensive instructional technology program. www.mff.org.pubs/ME155.pdf [15 June 2001]

Marzano, R.J. (1998). *A theory-based meta-analysis of research on instruction*. Aurora, Colorado: Midcontinent Research for Education and Learning.

Marzano, R.J., Gaddy, B.B. & Dean, C. (2000). *What works in classroom instruction*. Aurora, Colorado: Midcontinent Research for Education and Learning.

Merchant, G. (2001). Teenagers in cyberspace: An investigation of language use and language change in Internet chatrooms. *Journal of research in reading*, 24, 293-306.

Mikulecky, L. & Kirkley, J. (1998). Changing workplaces, changing classes: The new role of technology in workplace literacy. In Reinking, D, McKenna, M., Labbo, L. & Kieffer, R. (eds.) *The handbook of literacy and technology: Transformations in a post-typographic world.* Mahwah, NJ: Lawrence Erlbaum Associates.

Mitchell, A. & Savill-Smith, C. (2004). *The use of computer and video games for learning: A review of the literature*. London: Learning and Skills Development Agency.

Muir, D. (2001). *Adapting online education to different learning styles*. Paper presented to 'Building on the future', National Education Computing Conference, Chicago, June.

Nichol, J. and Watson, K. (2003). *British Journal of Educational Technology* 34, 2, Special issue devoted to "The Rhetoric and reality: the present and future of ICT in education" [UK]. Editorial.

Passey, D., Rogers, C., Machell, J. & McHugh, G. (2004). *The motivational effect of ICT on pupils*. Lancaster University: Department of Educational Research.

Schulz-Zander, R.I., Buchter, A. & Dalmer, R. (2002). The role of ICT as a promoter of students' cooperation. *Journal of computer assisted learning*, 18, 438-448.

Snyder, I. (ed.) (2002). *Silicon literacies: Communication, innovation and education in the electronic age*. London: Routledge.

Snyder, I. & Beavis, C. (eds.) (2004). *Doing literacy online: Teaching, learning and playing in an electronic world*. New Jersey: Hampton Press.

Thomas, S., Sammons, P., Mortimore, P. & Smees, R. (1997). Differential secondary school effectiveness. *British Educational Research Journal*, 23, 451-470.

Tierney, R. (1996). Redefining computer appropriation: A five-year study of 'Classrooms of Tomorrow' students. In C. Fisher, D.C. Dwyer & K. Yocam (Eds.) *Education and technology: Reflections of computing in classrooms*. San Francisco: Jossey-Bass.

van Dam, Andries., Becker, Sascha. and Simpson, Rosemary Michelle. (2005) Next-Generation Education Software: Why We Need It and a Research Agenda for Getting It. *Educause Review* April/May Vol.40, Number 2.

APPENDIX 1: USING TLF ONLINE CONTENT - TEACHER REFLECTIONS

After you have used a learning object/s with your class, please use this form to provide feedback to The Learning Federation. Please use a separate survey for each learning object you use with your class.
Your responses are highly valued.

1. Name of teacher

2. Are you

Male Female

3. Name of school

4. Country/state/territory of school

5. School sector

Government
Independent
Catholic

6. School setting

Remote
Rural
Urban

7. The school is:

Co-educational
Single sex - female
Single sex - male

8. What is the approximate total enrolment of your school?

9. Does your school include proportions of students who are:
(Please select as many as appropriate and also indicate the percentage).

	%
Language backgrounds other than English	
Indigenous	
Low socio-economic	

10. What is the name of the learning object you used with your class?

11. With which year level/s did you use the learning object/s?

K - P
1 - 2
3 - 4

5 - 6
7 - 8
9 -10
11-12

12. Key learning areas used for learning object

English/Literacy
LOTE: Chinese, Japanese or Indonesian
Mathematics/Numeracy
Science
SOSE/HSIE
The Arts
Integrated Unit
Other (please specify)

13. How was learning object used?

as an orienting or tuning-in activity
as a teacher-directed demonstration tool
to help students develop new knowledge, a concept or skill
to model or simulate activities not normally possible in the classroom
as a stimulus for discussion, developing higher order thinking skills or critical literacy
as revision or review of new knowledge, a concept or skill
as an assessment component
to allow students to work at their own pace and level
in conjunction with other ICTs (e.g with Word, PowerPoint, Internet research, data base and graphing tools, Inspiration, communication tools)
as a model for students to build new knowledge products
Other (please specify)

14. How did the students view the learning objects?

on CD-ROM
online, using a school Intranet, Learning Management System or digital resource repository

15. Which statement best describes the class environment in which the learning objects were used?

individuals or small groups using 1-5 desktop computers
half a class or more simultaneously using 6-30 desktop computers
individuals or small groups using 1-5 laptop computers
half a class or more simultaneously using 6-30 laptop computers

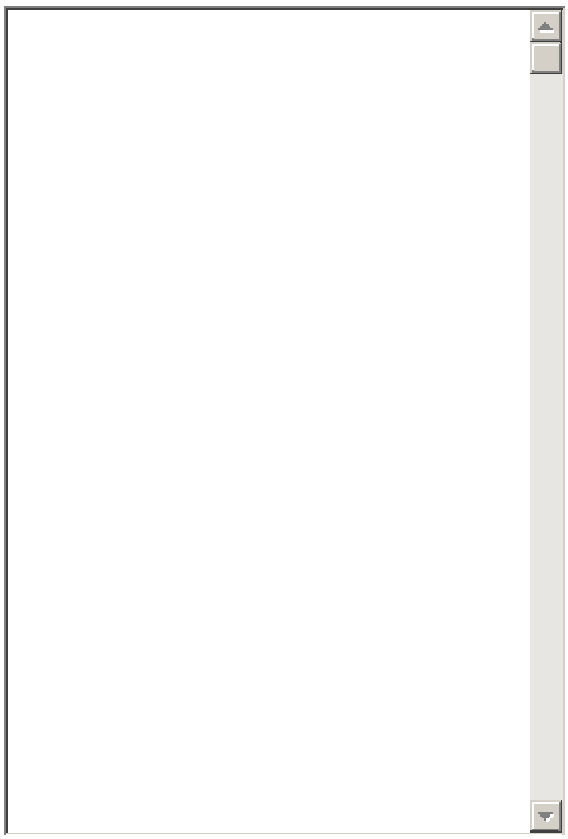
16. Did you use a Data show to screen the learning object?

Yes No

17. Did you use an Interactive Whiteboard to screen the learning object?

Yes No

18. Describe how you integrated the learning object into the lesson/lessons. Include topic, learning outcomes, teacher and learner activities.



19. How helpful was the learning object in supporting your teaching practice?

extremely helpful very helpful somewhat helpful not at all helpful

20. How helpful was the learning object in supporting student learning?

extremely helpful very helpful somewhat helpful not at all helpful

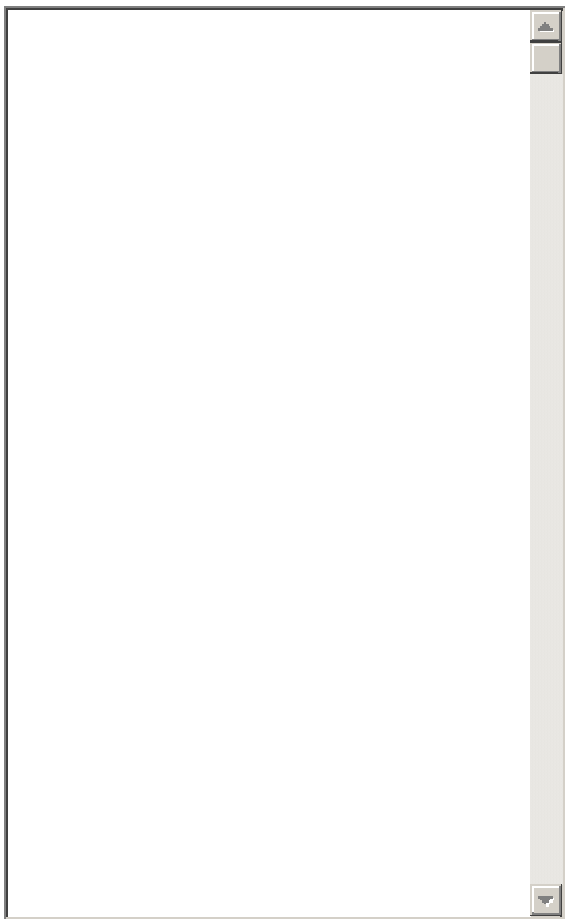
21. For your class as a whole, did the learning object improve…?

	None	A lot
Motivation		
Persistence with tasks		
Depth of learning		
Learning higher order concepts		
Collaboration with peers in learning		
Independence in learning		

22. For reluctant learners in your class, did the learning object improve ...?

	None	A lot
Motivation		
Persistence with tasks		
Depth of learning		
Learning higher order concepts		
Collaboration with peers in learning		
Independence in learning		

23. Please add any comments about the extent you believe the learning object is useful in supporting teaching and learning.



APPENDIX 2: USING TLF ONLINE CONTENT- STUDENT SURVEY

1. What is your first name?

2. Are you

Male Female

3. What year are you in?

Year 3
Year 4
Year 5
Year 6
Year 7
Year 8
Year 9
Year 10
Year 11
Year 12

4. What is the name of your school?

5. In what country/state/territory is your school?

6. What is the name of your teacher?

7. What is the name of the learning object you used?

8. How much do you agree?

	strongly agree	agree	disagree	strongly disagree
The learning object was interesting and fun.				
The learning object was easy to work my way through.				
The learning object helped me think about new ideas.				
It helps working with a partner to do the learning object.				
I needed a lot of help from my teacher to do the learning object.				

9. Write three things you have learned from doing the learning object.

1. I learnt
2. I learnt

3. I learnt

10. How helpful were these features/aspects of the learning object helpful for your learning?

	very helpful	helpful	not very helpful	not helpful at all
The sound				
The colour, pictures, animations and videos				
Interacting with the learning object				
Working at my own pace				
Repeating activities until I was successful				
Getting feedback which told me if I was right or wrong				
Getting information which told me how to do the activity better_				

11. Do you think using this learning object is a good idea? Why, or why not?

APPENDIX 3: TONGALA PRIMARY SCHOOL

WHERE WE ARE

Tongala is a small rural town in north central Victoria about 30 kilometres south-east of Echuca, and is a service centre for a major dairying area dependent on irrigation from the Murray/ Goulburn system. The main secondary industry in the town is a substantial Nestles milk processing plant. There is also an abattoir. The buoyancy of the area's economy is strongly influenced by weather patterns and milk, and water, prices.

There are two schools in the town, a government and a Catholic primary school. Students go to Kyabrum or Echuca for their secondary schooling. The government primary school has an enrolment of approximately 240 P-6 students mostly of Anglo-Celtic background. Few come from wealthy families.

The school has 10 classes all of mixed age cohorts, most with around 25-28 students and mostly comprising students from only two year levels. However, one — Pam Davis's class — contains students from Years 3-6 inclusive.

The school was opened in the mid-1950s as a consolidated school (ie primary and secondary grades) and much of its building stock set in extensive grounds dates from that period. One of its rooms is a computer laboratory with 15 computers. The wall connecting this room to the school's library has recently been opened to allow easy access between the two areas. As a result it has become easier to supervise students working in each area and individual use of computers has become reasonably straightforward. Each class has timetabled access to this area each week. It has been conventional to use this time for skill building in computer use.

The classrooms we visited were comparatively small and crowded. Each classroom had three of four computers installed which were networked through the school's intranet. The Learning Federation's materials with 50+ learning objects sorted by KLA and topic (made available through the Primary English Teachers Association's 'Special Forever' project, used in this instance as a vehicle for trialling purposes), had been installed on this network. The materials were, thus, accessible to all teachers and students.

Only two students of the 50 we spoke to did not have one or more computers at home. Approximately 80 per cent used computers for game-playing, about 50 per cent for the Internet and something like the same proportion for e-mailing and word -processing. One class was asked to estimate the time they spent using computers during an average week. About 25 per cent said two hours or less, about half between two and five hours, and the rest, predominantly boys, said more than five hours.

WHAT WE SAW

We spent most of the first 'block' (around 90 minutes) in Pam Davis's class. This was only the seventh day of the school year, but as a rule, Pam begins each morning with a two hour literacy block. After a recess break, a two-hour numeracy block follows before lunch.

There were 26 children in this class grouped into five ‘table’ teams all of mixed ages (as noted above Yrs. 3-6) and abilities.

The theme the class was working on was ‘The Antarctic’ and the room was decorated with masses of penguins and other relevant pictures and images. Shelving and some other furniture not in consistent use was covered with sheets of white (icey) plastic.

To tune in, the day began with a tables quiz, and despite the very early phase of the year the students were already very well schooled in its operation. The topic of the numeracy unit they were beginning with was **place value.** The quiz was followed by a place value game. Groups had to get the highest possible six-digit number by choosing where to place six single-digit numbers generated by a dice roll.

Pam then organised the table groups into a series of activity stations: an activity with concrete materials on the floor; three desk-based activities; and four students working at the computers in pairs on one of the 10 variants (different focal points and degrees of difficulty) of the learning object ‘Wishball’. (One of the computers wasn’t working this day.)

‘Wishball’ is specifically designed to help students understand and work with place value. Watching and listening to the students use ‘Wishball’ it was evident that it was generating practice in estimation, strategy devising and use of the operative functions. The screen has a target number and a start number. With a defined number of turns, you select the ‘spinner’ to give you a randomly-generated digit to adjust the start number to the target by adding and subtracting or, in some variants, using only one of those functions. The digit can be used as a unit, ten, hundred or thousand. You are supported on-screen by an abacus and a number line both of which provide an account of the impact of the choices made. It also contains a record of the number of turns taken and an instructions button.

The students using the object found it readily on the network, knew about the possible variants (‘I’m going for “Ultimate” today.’), and how to play. All the students were active and purposefully engaged, and those working on the computer no less so. Familiarity with the incorporation computer used as a conventional part of classroom learning/routine was evident. The students using the computers were most enthusiastic about this aspect of their classroom program, and were able to describe the contribution that use of the object was making to their understanding of place value. They were appreciative of the number line and the abacus to illustrate the impact of their moves and were happy to describe and discuss the strategies they employed. They also noted the beneficial impact of having to perform the functions mentally. (‘You’re sort of doing maths without doing maths if you know what I mean.’) The younger girls and older boys (in this case) of the pairs took turns with mouse and worked together practically and happily.

Later when we asked the students to write down whether or not they liked working with the objects and to explain their reasons there was only one dissenting voice (‘a bit boring’) with their reasons demonstrating a good deal of insight into what they were supposed to be getting out of this experience.

Clearly, it was as convincing a demonstration as you could wish for of the value of the learning objects to complement and enhance mainstream learning.

THE TEACHERS' VIEWS

Pam Davis

Pam returned to teaching this year following a year acting as project officer for the 'Special Forever' project. She is a very experienced teacher (26 years) who was two-year trained initially and subsequently completed a further one-year of formal training. Use of ICTs was not included in this study, either in terms of general skill development or classroom use. She describes herself as having picked up her skills 'along the way'.

One significant influence was her project officer experience when she was required to use a laptop regularly. It was also at this point that she encountered the TLF's learning objects. She says she saw their obvious potential and became 'desperate to try them in the classroom immediately. I thought the kids are going to love this. They are so multi-dimensional. They will be excellent for engagement and also for reinforcing what we are doing elsewhere. **They're too good not to use.** Initially I thought, I'm not very good at this … oh well, I suppose the kids will be; and we worked it out together. I have been watching their confidence just flourish. They love using them.'

'Frog Pond' (focused on environmental issues) was one of the first she explored. 'There were lots of things to do, lots of ways to go, and you could follow ideas in depth.' 'Rap Machine' (literacy) was another of her early interests. 'This provided for kids who needed extension and a higher level of challenge and engagement. There wasn't just one answer. There was plenty of variety and choice. Using these two objects in concert provided the opportunity to build in lots of other activities — writing tasks, getting in a guest speaker, and one of the best things was getting the kids to perform their raps.'

One of the features of some of the objects that she likes is that **'they help you teach things that are hard to teach in other ways'.** She used 'Wishball' as an example of this. 'The abacus and the number line are very effective scaffolds to support the development of strategies to generate understanding of place value.'

She introduced 'Wishball' via a data projector to the whole class explaining its purpose and how it worked. 'They picked it up very quickly. Now it is one of the work activities that we use regularly. It is a very efficient use of classroom resources. I notice that it's a very good 'share' activity. They talk through their strategies. I keep an eye out for kids who might get a bit lost. I'm looking over the whole range we have at the moment to see what else might be good for maths and numeracy. I also look all the time to see what else they might apply to. Like 'Frog Pond' and 'Rap Machine' — science and literacy at the same time, and when they are using 'Wishball' they are developing computer skills. **Anything that covers more that one area of what is a very crowded curriculum has to be valuable. And I find there are lots of opportunities for that.'**

'The bad parts? Well the machines don't always work and that's very frustrating. I can't be bothered with things that don't work and don't work immediately, and that would apply for most teachers. So I always have a back-up activity. We have a technician who comes to the school once a week and a trainee who is at school several days and who can fix quite a lot of things. Anything she can't fix she leaves for the technician.'

'I worry a bit about the other teachers and how to get the value of the objects across to them. There is an idea that I have come across that you can use them without teaching, like asking kids to just sit down and play this. I always see them as part of the unit of

work that we are doing. You can go much further and learn a lot more that way. I think we're proving that.'

Janice Hosking

Janice teaches a Year 3-4 Class, working half-time. She is the school's ICT Coordinator, a task which involves liaising with the technician and trainee and reviewing software for use in classrooms and the laboratory. She is also a very experienced teacher and has had limited formal training in the use of ICTs. When she returned to teaching after a period of family leave in the mid '80s 'computers were just starting to have an impact. We got a computer at home, a very basic one with no hard drive, and I started playing around with that.'

'At that time some teachers knew how to plug them in and that was about it. A small number were closed to the idea and weren't prepared to use them at all, the effort of learning new things I suppose. At that time we didn't use computers for teaching much, just ICTs skill development. There was some software for word attack skills and I became more interested in the possibilities of other programs. There was one called 'Creative Writer' that I got value out of. It was very kid-friendly. You could make codes with it, and it provided starter sentences … things like that. But the learning objects are a significant step up again from that. We have them networked for classroom use.'

'I play with them at home to see what they are about. It is something I can do with a laptop while other things are happening. Seeing all the possibilities is very time-consuming I find. One thing I would recommend is that all teachers should have the material on disk so that they can work on it at home.'

'When I am looking at the material I am thinking, how does it work? What happens next? Looking all the time for relevance to units of work. Sometimes I find objects which dovetail perfectly. One, for example, 'Number Partners', was based on a card game which helped to teach base ten and paired numbers. For kids who needed extension you could make the base number 20. I usually introduce the object using a data projector and then they work on it individually or in pairs on the classroom computers or in the lab after that.'

'The best thing about the learning objects is that kids get so engaged when they use them. But they help in other ways as well. We were doing work on Chance and Data, an area I'm not especially strong on, and we were using 'Sludge Machine' (an object which requires users to estimate the chances of producing a particular form of drink from a set of sources) and **I realised very quickly that they weren't as advanced as I thought they were. It was a very efficient way of doing that.**'

'They are clearly getting something out of the interactivity. They come up with things quite regularly that I hadn't noticed or come across. In 'Lifestyle of a Platypus' for example, suddenly the environment is being logged so there is an impact on the location of the nest and the environment in general. In another case in the same object a storm occurs. These aspects of the objects make them much closer to real life and its surprises and variation than you might otherwise teach. You can present all this lovely content which allows them to make choices and interact, then you can see very quickly what they've learnt.'

‘Another of the things I appreciate is the **choices** that are available in the set-up of an object. For example, the possibility of using sound and getting the object to ‘talk’ to you is very valuable with younger kids. I find that the recommendations for Year level use are not nearly as **flexible** as actual use indicates. You can use all sorts of objects with all sorts of kids depending on your purpose. You might want to go back over something for reinforcement or to provide younger students something with a bit more challenge and they’ll be up for it. I find the objects are all very different, so you can use them for many different purposes — introduction, reinforcement, extension — and you adjust, for example, for theme, level and place in a unit.’

‘What are the drawbacks? Having time to explore them I think is the main one. And you must explore them. On the other hand all kids enjoy using them. All kids.’

‘I wonder if there might be some notes, or an index of some sort that makes first access to them easier when you want something in particular. But I have used about 20 and looked at more and it is remarkable what is available.’

APPENDIX 4: BOGGABILLA CENTRAL SCHOOL

WHERE WE ARE

Boggabilla is the last stop on the Newell Highway in New South Wales before crossing the McIntyre River into Queensland and Goondiwindi. It is a small town with a population of about 750, a substantial proportion of whom are Murri people. This is Gamilaraay/ Kamilaroi country and just a few kilometres west from Toomelah, the last Aboriginal Mission established in New South Wales. The families living in both centres are closely related with many having moved from Toomelah to Boggabilla following Justice Einfeld's very public investigation of the former site in 1986. This area is well-watered and has some rich farming country (beef and cotton), but, where it exists, work for the parents and families of the school's students tends to be seasonal/casual farm labouring. Goondiwindi is a substantial country town very close at hand with its own schools which provide competition for the Boggabilla students.

The school is a central school and thus has both primary and secondary students, but the site is shared by a crèche, a new pre-school and a TAFE centre. It has about 80 primary students and 50 secondary students only four of whom are not Aboriginal.

The primary school is grouped into four classes — Kindergarten, Years 1/2, Years 3/4 and Years 5/6. There are computers in each classroom — six fairly recent and networked Macintoshes in the Years 5/6 room, with four live connection outlets — and 15 in a computer lab attached to the library, nine of which were working at the time we were there. These computers are new but use a DOS platform. While there are two computer coordinators, each classroom teacher is responsible for the management of their own computers and hence need, and get, some access to the rudiments of technical training. Any they can get is deemed invaluable. Hardware maintenance is a major issue. A couple of days before our arrival there had been a power outage which had brought the whole system down and messed up the settings and operability of a number of the machines. This is not an unusual event. Very high quality technical support is available but only from Moree (the centre of the school district, 120 kms away), and only from one person who services the needs of approximately 30 other schools.

The primary section of the school has five full-time teachers and one part-time teacher. The primary curriculum is delivered in three blocks; two and a quarter hours, one and a half hours and a one hour block respectively each day — literacy, numeracy and a range of other learning areas, one of which is computing where students use the computer lab to build their skills. None of the students in the class we visited had a computer at home, and it is likely that that would apply to all students at Boggabilla. Teachers of grades 5/6 rotate through the learning blocks and thus each class has a number of regular teachers.

Not all the teachers at the school are using the TLF learning objects, although their use is spreading gradually. One of the secondary teachers, for example, wondered if there were any resources which could be used to support the teaching of 'area'. Tracy was able to provide information about learning objects that would help in this regard. Their use has been introduced through professional development sessions at staff meetings. It was suggested that the most effective way to do this was to provide time and access for teachers to 'have a play' with them.

WHAT WE SAW

The class we saw was the numeracy block with the Years 5/6 group. There were 11 of the 15 students in the class present, two girls and nine boys with a very wide spread of ability. Tracy Ronnfeldt, the class's teacher, estimated that four were working at Stage One level (the lowest defined level of performance at primary level in NSW schools), one close to Stage Four (early secondary) and the rest Stage Two/Three.

This was the lesson plan.

Outcomes/ Indicators	**Teaching/Learning strategies**	**Resources**	**Assessment/ Evaluation**
MS3.2 Explains the relationship between the length, breadth and area of squares and rectangles. Give formula for area and use in an example. NS3.2a Recognises and represents common fractions, decimals and per centages. Uses common fractions and per centages in LF Design Briefs. NS3.3 Recognises and uses different notations to indicate division. Able to match 3 different notations.	*Warm up*: 10 mental calculations *Whole class focus:* • Revise area of square/rectangle, esp. 10x10 • Review division notations • Briefly revise 'Cassowary ' section of learning object (LO). • Demo of 'Plan a Park' LO to whole class using data projector • Demo of 'Plan a School' with per centages • Discuss group rotations. *Groups:* (20 min. rotations) 1. Computers with learning objects 2. Memory/dominoes with division notation cards 3. Easter maths booklet (inc. notation matching and per centages)	• New Wave Mentals • Division notation cards • Easter maths booklet • Networked computers with TLF LOs • Data projector	• Anecdotal records • Completion of BLM

The class proceeded along these lines. The students were sitting at table groups of three to five. The computers were set up in a corner of the room in two banks facing each other.

The students took some time to settle in the way that such classes do — missing pencils, not every one with their chair just where they want it to be, caps on or off, and so on, some of the students' minds still outside playing, or somewhere else.

The 'mentals' covered telling the time, tables, roman numeral conversion, and other sums and subtractions. Most students gave these a good shot, some of them getting all or nearly all of them right.

The revision of area and division notations did not take a great deal of time. The students gathered around the laptop/data projector, while Tracy ran through the objects, and the level of interest rose immediately. They were broken up into their three rotation groups and the students selected for the computer group first were delighted. The others were reminded, and consoled, that they would get a turn.

The students used the index provided for teachers for the learning objects related to this section of learning to access the objects (about 30 in total). Some of them began with the 'Cassowary Park' object; others went straight to 'Plan a Park'. 'Plan a Park' is a simple exercise in fractions on a segmented grid with a number of scaffolding prompts indicating halves, quarters and eighths (lawn, a swimming pool and so on) and introduces the idea of per centages. None of the students had much difficulty completing the task. One said, 'It's fantastic when there's talking', when the audio instructions were activated. This function was used by most of the students.

'Design a School' is a more complex version of 'Design a Park' with a greater focus on per centages and a requirement to make judgements about some of the proportions of the area to be used for various purposes. Most students got on to this object and a number did it more than once indicating that the 'burnout' effect was only modest.

It was during the use of this object that one female student provided the clearest evidence to date of direct learning as a result of her experience of using the object. She began by asking what per centages were and clearly didn't know. About ten minutes later she was not only showing that she could use this notion to work on the object but actually said, 'Per centages are parts of a hundred. So if it's 50 parts it's half of the whole lot.' The work on the objects generally made it very clear what students did and didn't know. One of the boys leapt from 'Design a School' to 'Design a City' which is a far more complex object and based on a 200 rather than a 100 segment grid. It was beyond his capacities, but he thought he might like to have another try at it, 'maybe in recess'.

The boys who had been not very engaged at the beginning of the lesson were all most attentive to their work on the computer, talking quietly to themselves rather than looking around for others to engage with. Tracy, the teacher, indicated that she would use the objects regularly but not for a great length of time with students of this age and ability level. She felt that about half an hour was a suitable period before changing the activity. It was, however, a most impressive display of their impact and value for students of this type. They were clearly adding to their mathematical knowledge painlessly and effectively.

THE TEACHER'S VIEWS

Tracy Ronnfeldt

Tracy arrived at Boggabilla just this year having won an appointment as Assistant Principal for the primary school. However, she was familiar with the area and its students having taught at Toomelah Primary School for some years previously and spent something like 15 years in this part of Australia.

She did her professional training at Townsville Teachers College which became James Cook University in her final year. This training did not include any reference to ICTs. At her first appointment, however (in Bowen, Qld), she encountered a colleague who was 'right into Logo and I don't know whether it was his enthusiasm or not, but I saw how using this sort of thing just sucks kids in. And I got interested that way.'

Six or eight years ago she became more interested and active in her incorporation of ICTs into her classroom practice. 'I was interested anyway, but we got some Apples and

used ‘Kidpix’ and things like that. We also began producing folios of kids’ work on the computers. The best help then was the CAP (Country Areas Program in NSW) website. They had some research modules on there which were just great to start using and to think about.’ Colin Gould, a project worker with CAP, provided ‘tremendous support. Technical stuff, navigation, resources, knowing what’s around. He was fantastic.’

The biggest headache Tracy has is technical problems with the hardware. ‘It’s so frustrating. You have a great lesson, it’s all organised, and then something happens and you have to adapt and start again. It’s very annoying.’ The other issue is time, ‘exploration time. To use the learning objects effectively you have to have time to look through them properly. They all have their own distinctive features that you have to be aware of.’

Tracy believes that those problems are considerably outweighed by the value of their use. ‘The kids all enjoy them. They are very engaging. The use of computers in itself is a novelty in a way it might not be for many other kids. The visual element is very powerful, and it’s more of a game rather than what they sometimes think of as learning. You can have too much of sitting down and working with paper and pens in a classroom. It helps to break that up, and to increase the range of activities. The independent way of working is valued, and I never have to keep them on task when they are on the computers. The audio aspect of some of the objects (clicking a button to produce instructions in audio form) is especially good, because some of our kids have low reading levels.’

As well as her other tasks, Tracy is the Support Teacher Learning Assistance and has had considerable experience in developing resources and materials across KLA’s. (She has also had experience as an Aboriginal Education Resource Teacher.) ‘I find the maths ones to be well-graded in terms of difficulty. There is something for everyone, and the kids pick up how they can be used very easily. They really do learn so quickly with them.’

APPENDIX 5: GEILSTON BAY HIGH SCHOOL

WHERE WE ARE

Geilston Bay High is very picturesquely situated on the eastern side of the Derwent Estuary a few kilometres north-east as the crow flies from the centre of Hobart but rather more distant by land. Established in 1972, it has had as many as 800 Years 7-10 students but now has approximately 310 who enjoy plenty of space and excellently maintained facilities.

These students come from a mix of economic backgrounds. The immediate environment of Geilston Bay is solidly middle class with a mix of professional and blue collar workers, but the school is close to and draws from the eastern shore government housing communities like Risdon Vale and Gagebrook. Bridgewater High School, located in one of the most economically depressed areas of Tasmania, is the next secondary school going north. About 55 per cent of Geilston Bay High's students are provided with the government assistance for low SES students. The school has 'many caring families in difficult economic circumstances' was how one teacher described the situation.

For some administrative purposes the school is divided into a Junior School (Years 7 & 8) and a Senior School (Years 9 & 10). Each Year level has three tutor groups as a base for pastoral care and class teaching. Each tutor group teacher teaches a subject to the tutor group as well as providing daily tutor session each week. The school has 24 teachers and provides the conventional range of secondary subjects at present but is in process of revising its offerings in keeping with the Essential Learnings initiative currently being implemented in Tasmanian government schools. The staff is presently putting any surplus energy into thinking about the issues generated by this initiative and how they might be resolved locally. This has implications for the time available for matters such as the incorporation of online learning in classroom practice. It was suggested that systemically across the DOE this had diminished as the impact of the Essential Learnings initiative has increased.

There is a mini-computer lab with about ten good quality and up-to-date computers in each Grade area. The same sort of facility exists adjacent to the library, and a separate senior laboratory has about 25 computers for student use. The school's teachers use ICTs in various ways, but mainly for word processing and Internet research. A couple are exploring the potential of blogging, and other collaborative projects but only one has a significant online focus for her work.

WHAT WE SAW

We saw a Year 9 class of 23 students (15 girls) use the learning object 'To Catch a Thief'. The structure of the class can be gleaned from the instruction sheet provided to students.

> **Tuesday 15th March**
> So far we have gained information about Ross [the Tasmanian town] and the Female Factory by using written resources. We had an excursion planned but have yet to undertake this.

Today we are going to check out our detective skills, see whether we have these well developed, and know what we need to do to solve a mystery. This will be important as when we go to Ross we will need to have good detective skills.

Go to:
My computer > Library drive > Subjects > SOSE > Mrs Corby

Then use the HTML file 'To Catch a Thief' as listed here:

1. Kristie, Matt, Shannon, Natalie, Aaron, Teegan, Sollest, Joe
2. Riana, Natasha H., Daniel, Tamara, Ashley, Ella, Michael, Samantha
3. Nick, Natasha T., Tamika, Nicole, Christie, Jamie, Reece, Sammi-Jo

Give it time to load, listening carefully as a robbery is taking place whilst it loads. Click Start.

• Interview Suspects
• Watch security video
• Check crime lab

You will need to watch carefully, listen to instructions and take notes in each section as you go. To do this click on the NOTES button after each section. Tick what you think is correct.

• When you compete each section you must then head to Police Headquarters.
• Check clues. If some are incorrect, go back and check.
• If correct, go to the line-up and choose your thief.
• Check your evidence.
• Did you catch a thief?

••••••••••••••
Our second step is to see what it might be like to go on an archaeological dig, what will influence our choice to dig and what we could find. You might like to think back to your drawing of the Ross Female Factory. If incomplete, check the resource clue map I have given you.

Go to **Webct** to the Discussions to Ross and follow the link on my message posted to you for today. There is a site to dig up and, when complete, a message to post.

The class began in the normal classroom with an introduction to the topic of the lesson series — Heritage — and to the task. We want to solve a mystery, what can we use to help us find out? What is evidence? What can you use for evidence? How do you gather it? And so on. It was not a lengthy introduction, just enough to settle the class who then moved into the next room, the senior school computer lab. The lab was set up with computer stations extending into the room as well as along one side. The students worked at one computer each although there was a good deal of productive and 'on task' exchange between small groups.

The start-up was as quick and efficient as it could be among 25 Year 9 students. Some had forgotten their passwords, but most navigated their way to the object quite readily.

The object, while designed to support development in literacy is about observing, collecting evidence and matching it to an outcome, ie, catching a thief who has stolen a painting from an art gallery. Some evidence has been caught on the surveillance video, suspects can be interviewed, and a number of artefacts appear in the crime lab. Notes have to be taken which discriminate between possibilities. Once those notes are complete a choice can be made between suspects. It has three levels with the same broad story line and elements, but the quantity and difficulty of the text students work with increases, 1>3.

All the salient information was contained on the instruction sheet. I am not sure how many students consulted this sheet consistently but a number with whom I was sitting found the object, got into it and used it intuitively after that. This created difficulty for some students (a small number) because they worked their way through the first section of the object without realising that they were required to complete the notes before moving to the second stage. The object also contains instructions to this effect. This is just something about how it might be expected that objects will be used, ie via the plunge method, rather than the careful survey of the territory. When objects have a little more complexity than is customary this can yield problematic but valuable results for the user.

The students quite evidently enjoyed the use of the object and most were highly engaged for 20 or so minutes in its use. They then turned to using another object related to the Ross Female Factory from NMA histories (Australian History Mysteries series). With this object you click your way through 50 identical plots of land, on the way possibly turning up artefacts which have some attached information. The four students I asked about this didn't think it was very good — 'boring' was the unanimous term. The teacher however, noted that at least four, (possibly different students to those I spoke to) were able to use this object as a stimulus to some very useful reflective thinking. It did provide an interesting comparison with the TLF object in terms of interactivity, complexity and interest level. It was, of course, precisely related to the content of the topic under way. This experience was a reminder of the way in which teachers mould both content and process to the specific cause of learning, and how flexible, adaptable and quick they need to be in that regard.

The students were at various stages when the period finished. Some had completed their work; others were still working on the NMA object. It would have been useful to see the next lesson or lesson series, on this topic which would have included cross-reference to learning activities and experiences. The way in which the object had been 'embedded' would be much more apparent, and its use and value far more manifest. However, in this lesson it made an obvious contribution to the interest level of the students and provided a point of reference to go back to and pick apart in more detail for the future.

THE TEACHERS' VIEWS

Pat Corby

Pat's career has some unusual aspects. She trained as a pre-school/kindergarten teacher in New South Wales and worked in this role for more than five years before becoming a social worker. She spent 11 years in this capacity before retraining and returning to teaching, at secondary level, in 1986. She completed a degree in humanities via Deakin

off-campus arrangements 1981-86 and followed this in 2000-01 with a post-graduate diploma in ICTs through Monash University ('a great course with a very practical focus'). At the time she was teaching at a small K-10 school on the east coast of Tasmania. 'In schools like that you need to cover so many bases, and I'm a great one for believing that if you teach something you really need to know what you're doing', is the way Pat describes how she developed her interest in using ICTs in the classroom.

This interest has evolved significantly through involvement in local Tasmanian Departmental initiatives and, in 2003, participation in the Icarus project sponsored by the European Council to support development of online courses. She did so well in this three-month course she was invited to be a moderator. She has also been a judge for the international Global SchoolsNet competition for web-based projects focused on investigative research. In addition Pat teaches two online courses (Business Studies and Creative Writing) for the Tasmanian Online School to students in different locations and supports two groups of students at Geilston Bay in LOTE learning (French and Japanese) by distance mode.

'I tend to want kids to do *and* to think, and I am always looking for a range of ways of communicating. ICTs provided an answer to a problem. At St Mary's we had students arriving at Year 7 from even smaller schools like Fingal and Bicheno, and I wanted to ease that transition by setting up a communication process with them before they came. A "virtual bridge" we called it, set up in three locations breaking down this barrier most successfully through the use of some of the communicative functions of ICTs. Ref: http://www.curriculum.edu.au/eq/summer2002/html/bridge.htm

'I have watched it work in both teaching and pastoral care. There is a responsiveness to e-mail. You know what it's like getting a letter, how much fun that can be, and when you write back you don't have to spell or write perfectly. It can be a great way of building links, but is not without its problems of course. I have long thought that ICTs must be effectively integrated into the curriculum. There is a place for specialised computing subjects and we teach them at this school. In fact, I teach Years 7 and 8 computing; but it can't be a stand alone process. ICTs are educational tools. I want them to be as accessible as dictionary — just another tool to communicate, to share, to develop knowledge.'

Pat shares oversight of ICTs teaching and use at Geilston Bay with another teacher. She is also the school's 'online mentor', supporting the development of the use of ICTs by other staff. The staff by and large has very good ICTs skills. All Tasmanian government teachers are required to complete three skill development modules and most at this school have done four. The school has a listserve which is not heavily used. 'You can only move as fast as teachers feel comfortable, and there are other issues dominating at present. You nudge away at these things and pass on links or objects that you think people might find useful.' A student recently won an award for construction of a file in Flash. This was generally applauded and shown at an assembly.

Pat encountered the TLF's learning objects following notification of their availability late last year. Some professional development introducing the objects had been offered but she was unable to attend. She accessed them during the holidays, looking for ones that she thought could be used in her classes, that 'would fit in. I knew we would be doing work on Heritage this year which would include "discovery" — observing, asking people, looking at and weighing evidence.' She found two that she thought she could use — 'Trans Tasman Challenge' and 'To Catch a Thief'.

Among the reasons she thinks working with digital content in the classroom is valuable is that it can provide learning situations that can't be provided in other ways or which can only be provided with great difficulty. She referred to the dissection of a cat (also mentioned by Nicky Hinton at Melrose High) as a good example. Digital content also 'adds an innovative dynamic. You still have speakers, videos and so on, but you use every means at your disposal to engage your kids and develop their knowledge. Digital materials are more authentic, more real than just diagrams.'

'The first time kids use something, it's a game. They tear through it and explore all the bits and pieces. It's fun, it's different. Let's try it. That sort of thing. Then when we go back to it together, you can start building a deeper level of discussion. How did that connect? What did you see? What clues did you pick up? What's something you know that's similar?'

'The main problems are technical accessibility and knowing what's available. I'm very keen to use any new resources, but they're the issues for me.'

APPENDIX 6: MAGILL PRIMARY SCHOOL

WHERE WE ARE

Magill Primary School is nestled at the foot of Adelaide's hills about eight kilometres east from the central business district. Together with a Junior Primary School, the school is sited in a comparatively affluent area with a significant Asian population (Chinese, Korean, Singaporean) on a corner block close to the University of South Australia's Magill campus.

The Primary School has about 560 Years 3-7 students of 55 nationalities. Approximately one quarter of these students are School Card holders, the conventional South Australian measure of socio-economic disadvantage. Children from non-English-speaking backgrounds make up around 40 per cent of the total enrolment. Some of these are very recent arrivals with minimal English (but often good computer skills). The school has19 classes mostly grouped by age cohort with a staff of 40, including support staff.

The school buildings are about 40 years old, double brick, and set in very pleasant surroundings. Inside, among other things, are two computer suites, each with 16 Pentium 4 computers as well as a pod of 10 of the same computers in the school's Resource Centre. Another pod of four older computers is accessible from LOTE rooms and students have access to one computer in each classroom. A parent survey conducted in 2003 indicated that 97 per cent of students have computer access at home and 91 per cent have Internet access. Students mainly use their home computers for playing games, school related activities and e-mail.

Most teachers make both regular and informal bookings of the computer suites as the need arises.

An Assistant Principal (AP) in Learning and ICTs, Ms. Jackie Miers, was appointed to work in both schools from 2004 to 2008 — an unusual situation. A computer technician employed for 35 hours per week also works across both schools providing technical support. He estimates that about 20 per cent of his time is spent on 'fixing' hardware, software, network and other technical issues. He spends the rest of his time supporting staff in their computer use.

The Primary School has a strong focus on the integration of information and communication literacy skills into the curriculum and the AP (Learning and ICTs) works in partnership with the teacher librarian and classroom teachers to facilitate this. Over time, each teacher will work intensively for five consecutive weeks with these ICTs and Resource Centre specialists to develop a unit of work aligned with the SA Curriculum Standards and Accountability framework. Each teacher is released for a 2-3 hour planning session with these two colleagues. This process is funded from both ICTs and Resource Centre budgets. The units of work are written up as examples for other teachers and as records of accountability.

WHAT WE SAW

What we saw at Magill was an example of the approach encouraged through the teacher development process, the central element of which is that learning objects should be embedded in and connected with other related learning experiences rather than treated as isolated entities. This approach has been theorised at the school, conforms effectively with the ideas behind the SACSA framework and has produced (through the professional development process) a number of 'learning activity sequences', built via the TLF's BELTS (basic e-learning tool set) learning management system.

This can be illustrated through the lesson plan for the class viewed — 'Threats to the Reef'.

> *Lesson Content*
>
> 1. http://www.quicktopic.com/29/H/YYWDsCVS9Y3T
> Post a message to the forum stating what you think the worst threats to the living things that inhabit the Great Barrier Reef are, and what you think can be done about it.
>
> 2. Underwater Discovery: level 1 [the learning object]
> A coral reef is under threat from an oil spill. Your task is to make an underwater dive and search for five species of sea creatures. When you find them, record their names and write some information about them in the Word document below. While you are searching think about the impact an oil spill could have on the living things in this underwater environment.
>
> 3. Recording sheet2.dot
> As you find each creature, write its name and information about it on this recording sheet.
>
> 4. http://www.quicktopic.com/29/H/HcH6Hj5Cw9U
> After swimming through this underwater environment, what impact do you think an oil spill might have on it and the creatures that inhabit it? What can be done?
>
> 5. http://www.surveymonkey.com/s.asp?u=85725534078
> Complete this survey and tell The Learning Federation what you think about the Underwater Discovery learning object.

Thus the learning object is incorporated in a larger sequence of learning activity, all functionally-based in computer use.

The class we saw was conducted in one of the computer laboratories with 16 high quality contemporary computers installed around the periphery of the room, networked and all working. The class was taught by Jackie Miers who used a computer, also networked, and a data projector.

The class was a Year Five group of 28 students including a small number of recent arrivals with limited English skills. It had been working on the general theme 'The sea environment' for some time previously. The session began with a reminder of that fact and questioning about whether any of the students had used a learning object before. Four or five appeared to have done so.

The class was asked to log on to BELTS. This process was modelled from the lap top and data projector. Students were run through the process of screen maximisation, one of a number of points in the lesson where an opportunity was taken to introduce or reinforce skills in computer use.

This was followed by an oral question and answer section setting up written responses to: 'What are the worst things that could happen to the Great Barrier Reef? What can be done about them?' This elicited responses like: dropping an anchor on the coral breaks it (reiterated several times), pollution, rubbish and the impact of Crown-of-Thorns starfish — the first and last of these responses suggesting that the students had been working on this topic recently. The students, mainly working in pairs, were asked to post their response on the quicktopic site. This occurred quite swiftly and the teacher reviewed the early results of this process again via the laptop and data projector.

The learning object was introduced. The students collectively were gripped by the sight of the sting ray undulating through the background of the underwater scene. The function of the object was explained. Navigating via the mouse and buttons, it is possible to explore around this underwater setting to locate and 'photograph' sea creatures. When this is done successfully its name, a photograph and a paragraph of information about the creature appear.

The students were straining at the leash at this point and moved into the use of the object without the slightest apparent difficulty. Once creatures had been located, they were required to make notes on a separate Word document eliciting an interchange between applications. This seemed to cause no difficulty either. I asked a number of the students if they would consider copying the text from the object and pasting it into the right space on the information sheet. They reacted to this idea with the appropriate degree of shock and the reminder that 'you must do your own work and put it in your own words.' The information going on to the sheet seemed to be drawn largely from the photographs rather than the paragraph, so I also asked if they had read the paragraph. The five or six I asked were able to provide evidence that they had. In addition, only in one case, that of a new arrival, did there appear to be any difficulty in sharing mouse control and working together happily and effectively.

In the time available the class didn't get much further than this. Again some of the student work was displayed via the data projector. They had been very engaged and interested.

THE TEACHERS' VIEWS

Jackie Miers

Jackie Miers is a very experienced teacher. She began as a classroom teacher some thirty years ago, took some time off to have children and, after returning to work, undertook further training in teacher librarianship. She has a very longstanding interest in computing and digital educational resources. In 1990 she began further study and completed a degree in Computers in Education in 1992.

She has developed her own website which provides a bank of digital learning resources and weblinks, and is currently exploring the possibilities of blogging. 'Computing', she says, 'is her hobby, her life. I'll often be looking round the web until midnight.' She has

always maintained a teaching load in concert with her work as a teacher-librarian and over a long period has noticed that where she 'has the kids on computers for an hour or two, there are no behaviour problems. They are engaged, motivated and getting things done.' Why is this important? What are they learning? How do you justify their use? — these are some of the questions she has been asking herself. 'Kids obviously like working with computers. Maybe they learn differently; maybe it is something to do with visual learning and the increasing pervasiveness and influence of the media. They could have different expectations and experiences than the ones we grew up with.'

Jackie is very actively involved in running professional development activities related to ICTs. The SA DECS program, Learning-Teaching Internet, run through the Technology School of the Future, is one of the vehicles for this. She has recently completed 24 workshops with another ten scheduled.

In her role as AP for Learning and ICTs she encourages and enables staff at Magill to participate in this course and hopes that all of them will have completed it by the end of 2005. In addition she oversees hardware acquisition, software review, provides information that she feels will be helpful to teachers, and collects and monitors information about current activity. One distinctive aspect of her role is the support she offers, together with her colleague Barbara Garner, to teachers in the preparation of units of work with digital elements. These can take many forms. Recently, for example, she has developed a simple website for use by the teachers of Chinese at the school.

As will be evident, she has had a long history with online learning, seeking out involvement and becoming a member of one of the TLF's Expert Focus Groups (Science 2) early on in the initiative. At the time and since then, she has remained conscious of the need for teachers to be able to 'put their own stamp' on the resources they use. She is also concerned that the objects should ensure that students will not, in fact cannot, 'miss the learning'. It must not just be another game experience, unlinked to what they already know and with nothing new absorbed.

The objects arrived at the school via the DECS BELTS server. Jackie believes that even the number currently available (substantial but small in terms of the total number planned) presents a major challenge for teachers in terms of becoming familiar with their content and their prospective value and use in the classroom. Nor is that the issue alone. 'It is not as if people are going to say, "Oh wow, learning objects! Let's have a look." They don't really know what they are or how to use them. And some teachers' computer skills are very very basic, and this is before they begin to use new resources in their classrooms. There is a major effort required to sell them and to educate teachers in their use.'

This understanding is one of the reasons why the school has put so much effort into supporting the implementation of digital resources into classroom practice. There are a number of 'learning activity sequences' which have already been constructed through the programming sessions with a number of staff. Topics include: Water Resources, Save the Lake, and The Hubble Telescope. By the end of the year there should be many more as it is intended that every member of staff will take advantage of the opportunity of working with Jackie and Barbara. While expensive of resources, it provides an important model for the sort of commitment required for effective implementation.

Jackie believes that the TLF resources are engaging, interesting and suitably pitched in terms of language. She has believed for a long time in the value of online learning. The

learning objects at Magill are not directly accessible by students. They must enter through a teacher password-ed portal. The reason is a reiteration of her central concern: they shouldn't be looked at as just a game; you have to do something more, and more effective, with them through the direction and focusing of attention to get the full benefit. The mediation of a teacher will remain of high importance.

Barbara Garner

Barbara is the school's Resource Centre teacher who works with Jackie in supporting teachers' programming for incorporating digital resources. She is also a very experienced teacher fairly recently arrived from another school where the use of ICTs had a very high profile in terms of resource-based learning. She sees working as they do at Magill with teachers as a natural evolution in the role of resource teachers.

Her views on the value of online learning echo those of Jackie. 'People want to take control of their own learning, and this sort of learning can provide that control to a very high degree. This is obvious with the kids. They love it. They're in charge.'

APPENDIX 7: CAIRNS SCHOOL OF DISTANCE EDUCATION (SDE)

WHERE WE ARE

Cairns SDE is located in a suburb of Cairns and has students not just around the corner (which it has) but in a number of countries overseas and at sea as well as students in more remote parts of far north Queensland. It is one of seven distance education centres in Queensland which service the needs of a wide range of students who do not or cannot attend a Mainstream school for one reason or another or whose schooling can be supplemented by access to remote resources.

It has about 485 students, of whom about 110 are being home schooled, 150 living in geographically isolated areas, 30 travelling, 25 at home for medical reasons, about 30 who are for one reason or another not engaging with schooling, about 30 overseas whose parents have decided it is better to keep in touch with school in Australia in this way, and a small number in juvenile justice institutions. The school also provides additional support for about 110 students whose home schools cannot offer a sufficiently wide curricular range to meet their needs. The SDE has 53 teachers who cater for students from pre-school to Year 11 (for the first time this year) which will expand to Year 12 next year following successful trialling of this process at another Queensland centre.

The 'School of the Air', as it was, began at this site in 1974 when the medium of instruction was booklets of text — text books and assignment/work books — and radio contact. Quite recently the radio contact has shifted to telephone 'bridges' ('teleconferencing' in other contexts). The school also does its best to provide face-to-face 'getting to know you' contact through a field program — a school camp once a year for all students who can get there, regionally-based mini-schools for students from these particular areas, and at least one home visit per year. But the teaching program has still been mainly paper-based. These materials have been produced by Access Education in Queensland, can be and are updated by users and are generally well thought of.

Considering the fact that 96 per cent of students' families had computers, 92 per cent were connected to the Internet and 60 per cent of these people having broadband connections, a move was made in 2002 to digitise these paper-based materials. This consisted of not much more than scanning the paper materials and distributing them on CD, rather than changing the nature of the medium more radically. (It is worth noting that a number of these homes in more remote areas have quite advanced two-way satellite connections, but they may not necessarily have power as generators are turned off to conserve fuel or for other reasons.)

The teachers we spoke to noted that there has been a longstanding concern to try to make the materials as interesting as possible, and to avoid the 'spoon feeding' that is hard to obviate in assignment-based learning for a wide range of abilities. For a number of years Internet sites suitable for research and other uses have been explored and various new means of interaction and communication have been investigated and instituted.

The SDE is organised into three sub-schools. The Junior School covers pre-school to Year 4, the Middle School Years 5-8 and the Senior School Years 9-11 (and 9-12 next year). To Year 8 the curriculum is integrated with the exception of maths which is taught separately. From Years 8-11 teachers teach separate subject areas. One of the major supports to schools is the provision of LOTE courses — Italian, Indonesian, German and Japanese. The school also has Learning Support teachers to assist students with special needs, and teachers of ICTs and multimedia.

The duration of contact varies from time to time but at present students up to Year 7 receive two three-quarter hours of contact a week, and Years 8 and up four half-hour sessions. What is the secret to making the most of this? Jim Buzacott says, 'Kids talk as much as possible; teachers as little as possible.' E-mail has added a significant dimension to the teaching because of the potential increase in the speed of turnaround of work. In the past, using surface mail has meant anything up to a fortnight from sending work to have it marked and commented on to receiving that feedback. Chat rooms, using EdQ's Blackboard platform, have been another valuable ICTs-based addition to the work of the SDE.

The advent of the objects was very warmly welcomed, however. They immediately provided a new dimension to what was trying to be achieved. Jim Buzacott was among the substantial number of on-line mentors encouraged through the EdQ roll-out of professional development support for the use of ICTs. TLF materials were encountered through this process and seized on with great enthusiasm. 'We **really** wanted to be in on the trialling process,' they agreed.

The objects have been circulated to students via CD-ROM, although the update to the version of Blackboard currently occurring increases the possibility of an accessible on-line repository. The paper materials the students use have been marked up with sticky dots or notes to indicate where an object is to be used. The students access these (and, of course, any others they want to use) via the standard index which is also used by teachers. No difficulty has been reported with this process. The teachers we spoke to reported that the students were very keen to discuss what they were learning through the objects, and in fact taking a much more active role in contributing to and shaping lessons.

WHAT WE HEARD

We were able to take part in a phone bridge exchange with three students and their parent home tutors, all geographically isolated, to talk about their experience of and attitude to learning objects.

All were enormously enthusiastic. One of the home tutors started the ball rolling, observing, 'My boys [Year 4 and Year 7] have absolutely loved using them. They love every part of it. It has improved their interest in computers and their skills in using them. They can work on their own, and they have such a good time! Anything that helps their learning I'm in favour of, but the learning objects have made such a difference.'

These boys had never shown much interest in computers to this point. Work, and life in fact, is mostly conducted outside for many such students and using computers does not have the same hold as it does on urban populations. 'They've never been into computers. It's been a real struggle trying to get them interested. They had some

technical [skill] lessons, but then the learning objects came along and they are just so motivated. They go back to them at night and have a play. One thing is, I can give one of the kids my full attention while the other works on the computer and it makes it so much easier for me.'

Her son talked about learning how to use a compass through 'Space Buggy', and how good it was to be able to hear the instructions as well as to read them. He loved the audio and the colours on 'Volcano'. His mother noted, 'He comes out telling me all about volcanoes and all the things he has learnt about them. This is unheard of.'

Amongst this group it was interesting how often the issue of colour came up. The text materials do have some colour in them, but the colour contained in the objects has made a great impression on these users. And the users are not only the students. 'We can understand what they're [their students] learning better now. We're learning ourselves.' 'Yeah', responded her son, 'I have to say, "Come on Mum. It's my turn now".'

Sharon, mother of 12 year-old Ashleigh living at Yourka Station north-west at Hot Springs, said, 'We really look for the learning objects. What it means for me is that I can just walk off and leave them to it and know they're learning.' This is obviously a significant matter for parent/home tutors who have their own work to do. 'They give all the facts, and they're very easy to follow. You can do the science experiments without all the set-up which we can't often really achieve, and you feel like you're working at a much higher level. It's given Ashleigh a real boost. I don't have to be on top of him to get him doing his school work all the time.' The other home tutors agreed vigorously and gratefully with this observation about changes in attitude and interest. Some other comments they made —

'They do so much print work. [Using the objects] breaks up the experience and there's lots of life, colour and activity in them.'

'I like the fact that a lot of them are self-correcting. The kids can work independently and aren't calling out to you for help all the time. They call out, but it's to show you what they've done, and that's a very different thing.'

'They don't think it's school work, but they're still learning at the same time. At night, or next day, he'll start talking about something that he's learnt. I'm sure the recall is far better. When he is reading normally he could be up in space. He's just not taking it in. But now he goes, mum and reels off fact after fact.'

'We're just so grateful for what this has done for our kids.'

The students' comments were more limited and focused on their enjoyment of using the objects and describing some specific details of what they felt they were learning. 'Just good', 'Fun', 'Great' and 'Really enjoy them.'

We also briefly visited a Year 5 class in action. The teacher asked her students about using the objects and had no trouble in eliciting a response. Travis said a number of things which included: 'They're really great because there are so many more things to do, and you have fun.' Candice said, 'I enjoy them a lot, playing them after school and things like that. They're pretty easy, all of them. More like games, but better.' One of the students noted that she had seen some that a Year 6 sibling or friend had been using,

and thought he or she would like to have a go at them quite soon. There was no doubt about their enthusiasm.

THE TEACHERS' VIEWS

Theresa Felatar and Jim Buzacott

Theresa is the technology coordinator at Cairns SDE. She has been teaching for 14 years and is in her fourth year at this school. She trained initially in early childhood education at QUT. There was no reference to ICTs in her initial teacher training. In her last term of university she remembers seeing a woman typing on a computer and that that might have been her first encounter.

Her husband, an accountant, got her further interested. In 1992 he suggested to her that computers 'were going to be in all schools one day', a view which she tended to see at the time as rather misguided. But as she began work in a pre-school centre she began to see ways in which they could be of service. She talked the parent group into buying an Apple IIE and it became part of learning centre activity as well as providing better quality printing and word processing facilities. Subsequently she also taught students with disabilities and noted how they gravitated towards the computers and the benefit they got out of using them. She has also had experience working with Indigenous students and found that they were of considerable value for them as well. She needed little more convincing. Her further study took place in Tasmania where she completed a degree course followed by a Masters degree. The Masters degree focused very extensively in ICTs and their educational use.

Theresa's responsibilities include developing the Learning Technology Program for preschool to year 8. This involves developing alternate assessment tasks to the traditional paper-based materials that encourage the students to use and learn information and communication technologies. She is also responsible for in-servicing the staff at Cairns School of Distance Education in using new and exciting resources such as the learning objects, discussion forums, live chats and Internet resources to enhance the students learning. She also produced and maintains the school website which is a valuable resource for students, home tutors and teachers as it is a major portal to the school. Theresa believes that it is vitally important that the students' home tutors (primarily parents) are confident in using all the new technologies and are able to see the benefits that these technology resources bring to their children studying through distance education. Theresa is currently travelling to the isolated areas and running technology workshops for home tutors only. Confident parents mean confident children. Technology takes the 'distance' out of distance education. Information communication technologies enable the students to work collaboratively, share research projects and get feedback from their teacher and classmates instantly. They no longer have to sit alone to do their work and wait for weeks to get feedback from their teachers.

Jim has been teaching since 1969 and has been at the SDE since 1994. He is Head of Curriculum (Middle School) and has a class group. He too has had a long standing interest in technology and its educational uses. He remembers a Tandy TR which he used in 1982 with a Year 7 group as part of a range of optional activities. 'Computer programs 'were provided along with cooking, woodwork and so on. He notes that when he came to the SDE in 1994 there were only four computers in the whole school, although the teachers were quite interested and were beginning to seek access in various ways. He could see the potential. 'We're always looking at ways we can increase the

impact of our work. It's all about enhancing delivery but especially communication. That is tremendously important for us.'

Then there was the roll-out of 'Blackboard' in which the school was involved, and some of the potential (discussion forums, live chat rooms, live whiteboard, etc.) noted above started making itself felt. 'So we quite rapidly developed access to computers, teachers were keen; we visited lighthouse schools and started working towards becoming one ourselves.'

'You can see how beautifully these media fit with our requirements and the learning objects as well. You have spoken/audio help for students with low academic skills, there are dozens of learning and teaching tools that kids can get access to. We just looked at them and said, "Oh wow. These are going to work so well with the kids".' (Jim)

'The objects are so good at facilitating learning how to learn. You are often required to take on a role and become part of the game, you know, the author of the story.' (Theresa)

Today the learning objects are not used very much with the Junior School students although they are used with Years 3 & 4 students. They really come into their own in Years 5-8 and have much higher levels of use. 'There might be a greater need there. It's easier to identify clear cases of reluctant learners at that age, and if you look at a profile of our students you will see that a significant number are our students for that very reason', Jim noted.

He went on, 'We have quite a lot of kids with severe learning problems. I find that they have a better chance of interacting and achieving through using the objects. They like being able to make choices and work on their own. It's not just that they have learning problems. It's the particular nature of their problems we have to accommodate. This is often about being shy and dysfunctional in mainstream situations. To be able to offer this sort of support is just great.'

When asked about problems with the objects, Theresa and Jim thought for a minute and suggested that size might be an issue when downloading from online repositories. However: 'Learning objects can only make life better for the kids we teach. The only real problem we've got is that there are not enough. We can't wait for our next instalment.'

APPENDIX 8: MELROSE HIGH SCHOOL

WHERE WE ARE

Melrose High is situated in the Canberra suburb of Mawson in the central region of the Woden Valley about eight kilometres south of Capital Hill. Over the past decade or so this area has undergone a broad demographic change becoming more affluent and, in the words of one of the teachers at Melrose, 'solidly middle class'.

The school has approximately 820 Years 7-10 students feeding to the ACT's senior colleges. While drawing from four local primary schools, 70 per cent of its students come from out of this area. It has a substantial waiting list. Like most schools in the ACT it has extensive grounds and substantial building stock being refurbished in part at the time of this visit. Melrose High has four computer laboratories with about 25 computers in each. These computers are networked, with The Learning Federation's learning objects housed on a common drive. Computing classes are timetabled into these rooms and if other subject teachers wish to use these labs it is necessary to book. Early in the semester this is comparatively easy. As things gear up during the year it becomes less so. The school's computer equipment is serviced by a full-time computer technician.

The school has had a laptop program, the Computer-assisted Learning Program, for one class of Year 7 and one class of Year 8 students. Students apply for these classes and are selected on a number of criteria. These classes have presented substantial organisational and other issues and are currently under review.

The school's curriculum provides a group of core subjects at Years 7 and 8 while cycling through a range of Arts and Technology electives. In Years 9 and 10 all students do English and Mathematics as core studies and choose from a range of options to satisfy a pattern of subject choice. Two popular electives at this level are multimedia and computer programming.

Staff have been invited to learn about computer use in the classroom and to improve and refine their skills. One of the features of the 'Curriculum Integration Model' program referred to below (with widespread participation in ACT government schools) was the 'taking back and sharing' of what had been learnt. Of the staff of approximately 60, about ten have shown interest to this point. Four of these are in the Science faculty, one of the background features to this case study. Nicole Hinton has recently also had some time available to develop units or work/lesson plans related to learning object use. It was the product of one of these that we were to observe.

In addition, at the time of this visit, teachers in ACT government schools were being introduced to 'My Classes' and its digital portfolio functionality- 'My Portfolio', two learning management systems which will be the conventional vehicles for these purposes in this system.

WHAT WE SAW

The class we saw was a Year 10 Science elective group. The elective, Physics/Chemistry 2, is intended for students who plan to specialise in science in their further studies. There were 26 students, substantially more boys than girls and perhaps half of Asian background but all with good to excellent English language skills. They appeared to be generally very bright and most, but not all, had a high level of application to their studies in this class.

The lesson took place in one of the computer laboratories where the computers are arranged around the periphery of the room. About half the students were working in pairs, the other half on their own.

The learning object chosen for use was 'Give me a brake!' With this object it is possible to manipulate a series of variables (speed, mass (type of vehicle), road conditions, weather conditions, tyre conditions) to define and regulate a vehicle's stopping distance. The lesson plan was as follows.

Year 10 Physics Give me a Brake! 55 mins

Objectives	**Resources**
Students should be able to: • relate speed to braking distance • understand influence of multiple variables in analysing stopping distance • work with variables in carrying out investigations • relate the computer simulation to real life situations. Possible student misconceptions: • testing more than one variable at a time • understanding the concept and application of inertia	• Computers enabled with Macromedia plug-ins, Shockwave player and Flash. Computers also need Quicktime version 4 • Learning Object 18: Give me a brake! • worksheet: Give me a brake! • rubric for assessment • whiteboard and pens • Optional: digital projector and Smartboard (for teacher demo)
Lesson steps	**In Lesson Prompts**
• (15 mins) Set up computers and explain program. • (10 mins) Play time • (5 mins) Set tasks and explain students procedures. Explain fair testing and the role of variables. • (20 mins) Trial and collect results • (3 mins) Housekeeping and clean up.	• Students will open up network or CDs and open up 'Give me a Brake!' • Students will practise using the program and experiment with the skill of braking. • Students will collaborate with peers to design fair test and decide on variables and constants. • Students will create results logs and carry out first investigations. • Students to ensure they save their work and log off.
Homework	**Extension/enrichment activities**
• Students will review terms in glossary. • Students reflect on the relationships between motion, friction and inertia. Students record their understandings in generalised terms. • *Application extension*: list safety features of a car that counteract the force of inertia in braking and collisions.	• Use wooden ramps and physics collision carts to experiment with speed and inertia experiments. • Set student challenge for working out the best angle. (Need: chocolate prize for best group?) • Students design an experiment to safeguard an egg on a cart that collides with a block of wood. • *Assessment Item:* Amber Light Assignment — application of stopping distance concepts to determine the appropriate length of amber lights at several intersections in Canberra.

The text of the handout to students was as follows.

GIVE ME A BRAKE!

Your task:
Using Learning Object 18 'Give me a brake!' you will investigate the different factors that influence stopping distance of a motor vehicle.

You will complete the experiment report to address the question —
'What are the influences of 5 different factors on the ability of a driver to stop a motor vehicle?'

Experimental report requirements

1.After exploring how the learning object operates, you must design the procedure for your experiment. First you need to identify the variables.

The five variables are:

2.Design an experiment that tests one of the variables. Record the changes that you make to that one variable. To be a fair test record the conditions of the other four variables. They must be kept constant (Do NOT change them).

3.Design a results table so that all your data can be recorded.

4.Complete a full experiment report. Your report must include the following sections:
• aim
• procedure
• results table
• discussion
• conclusion

5. In your discussion you must answer the questions below. Write your answers in paragraph form.

Questions
1.State what you have learnt from your fair test of one variable.
2.Why is the condition of the tyres important in braking distance?
3.How could you best decrease the braking distance in icy conditions?
4.What is inertia? Which would have a greater inertia, an elephant or a mouse, and why?
5.How does reaction time influence the fair testing?

Check that you have included all of the required elements for your report, proof read it and print it out to hand in to your teacher. Check out the rubric for the requirements.

The purpose and structure of the class was introduced, and it proceeded in a close approximation of the plan. The introduction was short; the students did have their 'play time' which they took up with great interest and enthusiasm (big truck, flat out, icy conditions, bald tyres, wham!). After the set period they settled down to work on the tasks set out on their worksheets quite readily except for one small group which was engaged in its own activities. This is a class of mid-adolescents after all. There had been only one point of teacher intervention which was some discussion about the need to select only one variable and, for the purposes of a fair test, to ensure constancy in all other variables.

Most of the class got to the point of developing some results for the results table. Few would have got to the discussion questions. The learning object obviously worked well to that point. The students found it engaging, and it was precisely focused on the point of the lesson. All that was needed for an excellent general learning experience was a

little more time. The students filled in the reaction survey at the end of the period. The relevant results can be found below.

Perhaps the most interesting thing about the class was the teacher's role. It was the first time she had used a learning object in class. She was not familiar with the object or its learning purposes, and was working from someone else's lesson plan (her Science faculty colleague, Nicole Hinton). None of these factors appeared to impede the course or the success of the lesson. This suggests something about the possible stand-alone capacity of this object at least (and no further generalisations should be made in this regard given the very wide variety among the objects) when it was coupled with a well-formulated task sheet. It should also be pointed out that Onawe Siakimotu *is* a trained and experienced Science teacher and was able to provide support for a number of individuals during the course of the lesson. But, on the basis of this experience, using learning objects effectively in a classroom is not an extraordinarily complex undertaking.

THE STUDENTS' RESPONSE

As noted above the students filled out a reaction survey at the end of the period. These are the results to some of the items, indicating that they found the work interesting and valuable.

• ***How much do you agree?***

	SA	A	D	SD
The learning object was interesting and fun	30% (7)	65% (15)	4% (1)	0% (0)
The learning object was easy to work my way through	48% (11)	48% (11)	4% (1)	0% (0)
The learning object helped me think about new ideas	9% (2)	57% (13)	35% (8)	0% (0)
It helps working with a partner to do the learning object	22% (5)	39% (9)	35% (8)	4% (1)
I needed a lot of help from my teacher to do the learning object	9% (2)	13% (3)	43% (10)	35% (8)

• ***Write three things you have learned from doing the learning object.***
(Only one is included here. All stet.)

I learnt
1. How long a loaded truck takes to brake completely
2. it takes a long time to stop on icy roads
3. don't go at 220 km/h you will hit a cow
4. that different vehicles affect braking time
5. the difference it would make in your skid depending on the speed
6. that different variables affect the braking distance of a car
7. Computer's good
8. the five variables
9. how inertia affects braking distance
10. that different vehicles take different distances to stop
11. Trucks Are Hard To Stop
12. about the different types of tyres and there features
13. that different variables affect the results
14. how variables effect the breaking distance
15. how variables can be input into data

16. the five variable
17. there are a lot of factors in how long it takes to brake completely
18. How heavy objects effect breaking distance
19. that there are five variables that are affect the stopping distance of a motor vehicle
20. The importance of variables
21. It's important to write a logical report to record the result of the experiment.
22. That brakes are evil

• How helpful were these features/aspects of the learning object to your learning?

	Very Helpful	**Helpful**	**Not very**	**Not at all**
The sound	0% (0)	18% (4)	14% (3)	68% (15)
The colour, pictures, animations and videos	**48% (11)**	**48% (11)**	**4% (1)**	0% (0)
Interacting with the learning object	30% (7)	**61% (14)**	9% (2)	0% (0)
Working at my own pace	30% (7)	**52% (12)**	17% (4)	0% (0)
Repeating activities until I was successful	22% (5)	**65% (15)**	9% (2)	4% (1)
Getting feedback which told me if I was right or wrong	13% (3)	**52% (12)**	13% (3)	22% (5)
Getting information which told me how to do the activity better	17% (4)	**35% (8)**	**35% (8)**	13% (3)

• Do you think using this learning object is a good idea? Why, or why not?
(All stet.)

1. yes, because it helped me understand the concept of varibles better.
2. yes, it is fun
3. Yes because it makes the lesson by interesting by activley including us and shows us the uses for what we learn in class.
4. it is visual so it helps us realize when we should break
5. Yeah its ok, but i think i needed more time. the animations were very good and very helpful and its just a fun way to learn more things.
6. Yes. Because it helps students in many ways.
7. it was fun
8. i think that this learning object is a great idea to help students learn all about the variables of stopping distances due to speed, road and weather conditions, tyre and vehicle type. it he
9. Yes, because it is interactive, dude.
10. Yes as it gives you a visual aid in learning, which helps to learn in a different aspect to the classroom.
11. Yes it show people what to do
12. I think it was a good idea because it was an interesting and new way of learning
13. yes, because its fun, interactive and you can learn as well as have fun. i like the cars :) GO THE LOADED TRUCK!!!! w00t!
14. yes it is, because it helps to learn about what effects the breaking distance
15. It was a very good idea.
16. yea its more fun than normal class
17. I think it was a good idea because it was very interactive which was very helpful

18. yes, because it is an interesting way to learn other than the teacher telling me.
19. Yeah, it's a lot easier to focus on a task when there is a practical part that you can access all from the one program.
20. Yes. Because the way of using the software to learn physics is far more interesting and helpful than usual.
21. Yeah its good, but it gets repetitive and annoying.

THE TEACHERS' VIEWS

Nicole Hinton

Nicole Hinton is the author of the lesson plan and the student handout and a very active user of digital technologies for teaching/learning at Melrose high.

Nicole is a Science teacher in her fourth year of teaching. For her pre-service training she completed a degree in Science at Queensland University of Technology followed by an education qualification at the same institution. In both courses the use of ICTs was a conventional part of study. Course notes, activities and arrangements were online and it was expected that students would access them there. She began her teaching career expecting to use ICTs as a part of her classroom practice and she had endeavoured, sometimes in the face of considerable practical difficulties, to pursue this.

Nicole was actively involved in the 'Curriculum Integration Model' (CIM), one of the main programs in the ACT government sector's operation of the federally-funded Quality Teacher Programme. The purpose of this program was to provide teachers with professional development to enable them to 'integrate Information and Communication Technologies into teaching practice in all Key Learning Areas'. After some basic skill building, participants were required to design digital learning materials and activities to suit their school. 'I got involved with this early [in the first year of the QTP, 2000], and we did Keybooks, Hot Potatoes, some web design, things like that.' In the course of this process she met the TLF's ACT Contact Liaison Officer, Lea Chapuis, and expressed an interest in trialling and using TLF learning objects related to the teaching of secondary Science.

'I had a look at a few [objects], "Give me a brake", "Where does speeding get you?" and one or two others, all Physics-based actually; and I knew they'd go down well and the kids would love them because I enjoyed playing with them so much. That's a reasonable test I think. I'm very conscious of things that I think are too simple. However I'm often wrong about that. I've watched kids play these games based on the simplest pieces of "Flash" for ages and they don't get sick of them.

'We are working on an assignment related to amber light timing. You need to work out how to stop safely and so on. And this had to be a simulation and the object that supported that [the one used in the case study class] was very effective. The simulation function is very useful in Science with issues like safety, and expensive and complicated equipment and things you simply can't do apart from simulations. In practical work you try to make things as authentic as possible and often simulation is the best way to do that.

‘On the other hand there was another learning object I looked at, a simple one related to testing for acids and bases. You can do that cheaply and safely at school without any remarkable equipment so I wouldn’t use computers for that.

‘This process has got me going a bit. I’ve found other [non TLF] learning objects via Google which have sharpened my perceptions about what can be useful and what isn’t. There are a couple of very good ones based on Flash files — a game process related to the digestive system, putting the parts together in different ways, labelling and adding descriptions. There’s another very good one which is the dissection of a cat, and of course you can’t do that at school. There’s also heaps of dodgey ones. They provide almost no step up from a website and, above all, they have no interactivity, no choice of pace or content or direction.

‘The way I look at it is that I’m looking for resources that will expand my repertoire and save me time. I’m thinking how could I do this in the lab? Using the objects is just another teaching tool. Some of them, like ‘Where does speeding get you?’, have very valuable functions. Its about scalar and vector qualities and as a rule they’re very difficult concepts to get across. But in this case they can actually *see* the car travelling, *see* the impact of the speeding. It makes it so much easier to teach.

‘The best things about using the objects? Just a summary of what I’ve said really — you can simulate things you can’t do otherwise, you can sometimes get difficult concepts across more easily, it expands the range of teaching and learning activities, and variety is important. But number one is, it’s fun. One of the things I have learnt is that the class won’t concentrate until they’ve had a play with every button.

‘You must be selective I think, like you are about most things. As far as I’m concerned they’ve got to be really meaty. You must have some variety, and I wouldn’t use them too heavily. Perhaps three a term would be plenty.’

Onawe Siakimotu

Onawe, of course, was the teacher of the class we saw. Her story is instructive.

She is an experienced teacher, having taught for 15 years since 1998 in the ACT system and since 2003 at Melrose High. She has recently returned from maternity leave. When she began teaching in the ACT she had a difficult experience which implied that her ICTs skills were not up to professional scratch. This left a significant impression on her and she immediately took a number of courses via ANU and various libraries to improve these skills. She also became an active participant in the CIM program in order to upgrade her skills further and widen her understanding. She has also undertaken and completed tertiary post-graduate studies in ICTs in Education. ‘I had to do these things because of the way education is heading. It is important for me to feel competent in this regard.’

She has spent quite some time as a result thinking about the value and importance of ICTs in education. She sees that they provide skills which are transferable and lifelong, that are most efficient in terms of information collection and sorting. They are important for various careers. In terms of a learning process she is confident that the use of digital resources in the classroom increases the efficiency of the process by adding more dimensions, and increasing the range of available resources. She, too, comments on the

significance of increased learner control and has observed how much students appear to enjoy it.

While she had not used the learning object in the case study lesson, she uses a range of digital resources and tasks with her students as a matter of course, and is just coming to terms with ‘My Classes’.

APPENDIX 9: DIMENSION REDUCTION ANALYSES

Dimension reduction analyses were performed to obtain a smaller number of internally consistent variables from larger sets of variables. The analysis used was a Principal Components Analysis (PCA) on:

a) The set of items asking teachers if, **for the class as a whole** , the learning object improved motivation, persistence, depth of learning, learning higher order concepts, collaboration, and independence; and
b) The set of items asking teachers if, **for reluctant learners**, the learning object improved motivation, persistence, depth of learning, learning higher order concepts, collaboration, and independence

a) For the class as a whole

A PCA was conducted on the six items asking teachers if the learning objects improved learning for the class as a whole. Means and standard deviations for each item, and correlations between pairs of items are shown in Table A9.1. Using the eigenvalues-greater-then-one rule and a scree plot of eigenvalues against components, a one component solution was suggested. The component loadings (Table A9.2) show that all six items load strongly onto the one component. Cronbach's α (= 0.89) is large, and indicates that a scale formed on these six items is reliable. If any one item is dropped from the scale, Cronbach's α decreases, indicating that all six items should be retained in calculating the scale. The scale is formed by calculating the mean of the six items (after applying unit weights to each item).

Table A9.1: Means, standard deviations, and correlations (N = 299)

Class as a whole	Mean[a]	Standard Deviation	Correlations				
			M	P	D	L	C
Motivation	3.52	0.69					
Persistence with tasks	3.19	0.78	.68				
Depth of learning	3.12	0.75	.65	.72			
Learning higher order concepts	2.91	0.84	.53	.55	.73		
Collaboration with peers in learning	3.03	0.90	.49	.52	.51	.52	
Independence in learning	3.27	0.80	.56	.56	.59	.51	.50

[a] 1 = None …. 4 = A lot

Table A9.2: Loadings and communalities for one component solution

Item	Component Loading	Communalities
Motivation	.81	.66
Persistence with tasks	.84	.71
Depth of learning	.88	.77
Learning higher order concepts	.80	.64
Collaboration with peers in learning	.72	.52
Independence in learning	.77	.59
Percent of variance	64.8	

b) For reluctant learners

A PCA was conducted on the six items asking teachers if the learning objects improved learning for reluctant learners. Means and standard deviations for each item, and correlations between pairs of items are shown in Table A9.4. Using the eigenvalues-greater-then-one rule and a scree plot of eigenvalues against components, a one component solution was suggested. The component loadings (Table A9.5) show that all six items load strongly onto the one component. Cronbach's α (= 0.92) is large, and indicates that a scale formed on these six items is reliable. If any one item is dropped from the scale, Cronbach's α decreases, indicating that all six items should be retained in calculating the scale. The scale is formed by calculating the mean of the six items (after applying unit weights to each item).

Table A9.4: Means, standard deviations, and correlations (N = 293)

Reluctant learners	Mean[a]	Standard Deviation	Correlations				
			M	P	D	L	C
Motivation	3.43	.76					
Persistence with tasks	3.16	.83	.75				
Depth of learning	2.97	.81	.63	.75			
Learning higher order concepts	2.75	.88	.54	.66	.80		
Collaboration with peers in learning	3.02	.90	.59	.62	.63	.64	
Independence in learning	3.07	.83	.62	.72	.66	.66	.65

[a] 1 = None …. 4 = A lot

Table A9.5: Loadings and communalities for one component solution

Item	Component Loading	Communalities
Motivation	.81	.65
Persistence with tasks	.89	.79
Depth of learning	.88	.78
Learning higher order concepts	.85	.72
Collaboration with peers in learning	.81	.65
Independence in learning	.85	.72
Percent of variance	72.1	

The two new scales, labelled 'Class as a whole', and 'Reluctant learners' are used in the analyses in Appendices 11, 12, and 13.

APPENDIX 10: CLUSTER ANALYSIS – OBTAINING CULTURAL, SOCIO-ECONOMIC AND LINGUISTIC GROUPINGS

A Cluster analysis was performed on the variables:

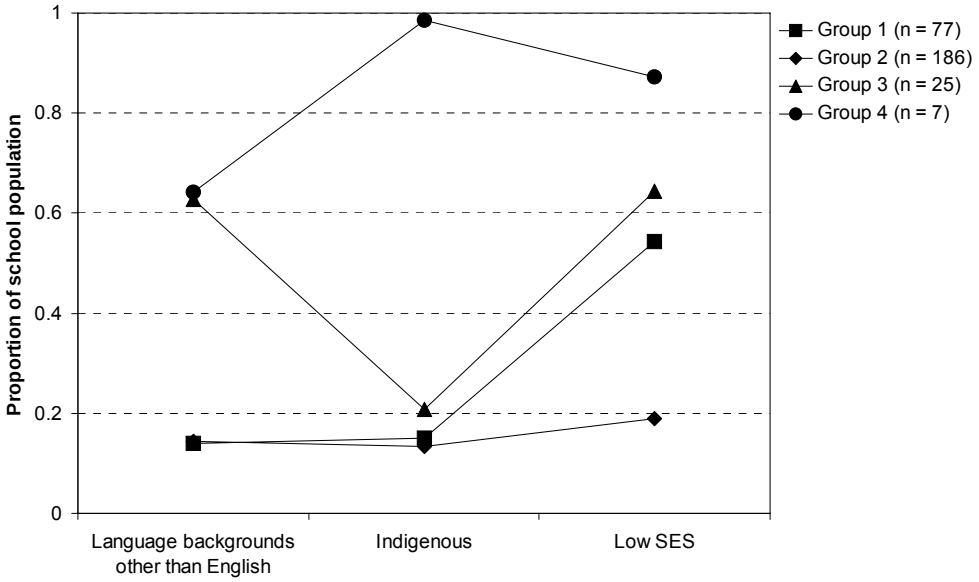
- Proportion of students who are from language backgrounds other than English;
- Proportion of students who are Indigenous; and,
- Proportion of students who from low SES backgrounds,

to obtain reasonably homogeneous groupings of chapters with respect to their profiles across these variables.

The clustering procedure employed was a k-means cluster analysis. All solutions from the 2-cluster solution through to the 8-cluster solution were requested, and the optimal number of clusters was decided on the basis of the additional amount of variance (η^2) accounted for when moving from k clusters to k + 1 clusters. If the increase in average η^2 in moving from k to k + 1 clusters was less than 0.05, then the k-cluster solution was taken to be optimal. That is, the more complex k+1 cluster solution was not considered when it explained an additional 0.05 of the variance or less.

The 4-cluster solution was taken to be the optimal solution. The 4-cluster solution explained an average of 0.70 of the variance in the three variables (an increase of 0.11 over the 3-cluster solution). The means for the four clusters are shown in Figure A10.1.

Figure A10.1: Mean proportions of LBOTE, Indigenous, and Low SES students for 4-cluster solution



The clusters are characterised as follows:

- Cluster 1: A cluster with small proportions of LBOTE and Indigenous students, but larger proportions of Low SES students; Labelled 'Anglo / Low SES'.
- Cluster 2: A large cluster with small proportions of LBOTE, Indigenous, and Low SES students; Labelled 'Anglo / middle SES'.
- Cluster 3: A cluster with large proportions of LBOTE and low SES students but small proportions of Indigenous students; Labelled 'Migrant / low SES'.
- Cluster 4: A small cluster with large proportions of LBOTE, Indigenous, and Low SES students; Labelled 'Indigenous / low SES'.

These clusters are used in the analyses in Appendix 13.

APPENDIX 11: MANOVAs – HELPFULNESS IN SUPPORTING TEACHING AND LEARNING, AND IMPROVEMENT IN LEARNING BY CURRICULUM SUBJECT AREA

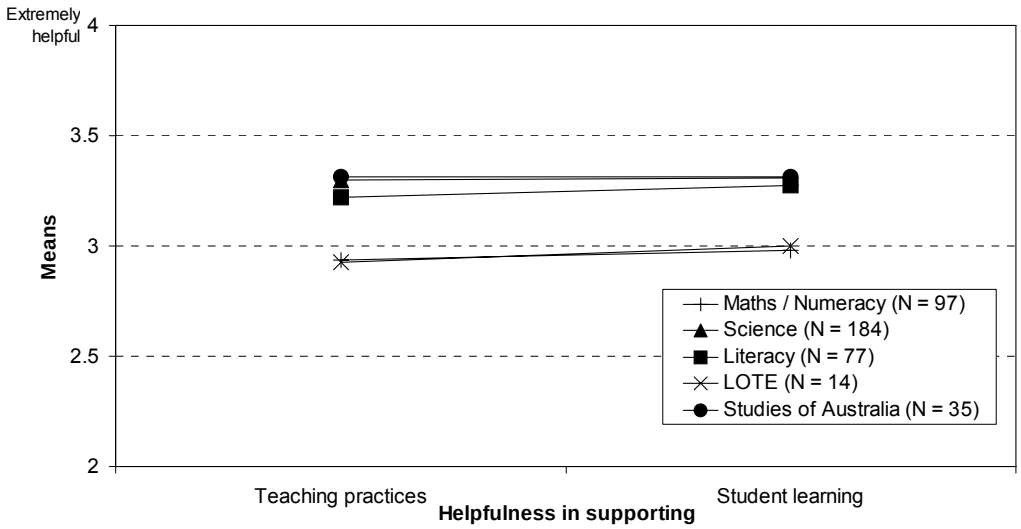
A 1-way between-subjects MANOVA was performed on the two Helpfulness items:

- Helpfulness in supporting teaching practices; and,
- Helpfulness in supporting student learning;

as dependent variables. The independent variable was Curriculum Subject Area (Math / Numeracy, Science, Literacy for students at risk, LOTE, Studies of Australia). The Curriculum Subject Areas are the areas into which learning object fall according to the Le@rning Federations' learning objects' catalogues. (In this appendix and those that follow, statistical significance is assessed at a level 0.1.)

Using the Wilks' Λ criterion, the combined dependent variable was significantly related to Curriculum Subject Area (Wilks $\Lambda = 0.95$, MV F (8,802) = 2.35, p = 0.017). Univariate F-tests were used to further investigate the effect for Curriculum Subject Area. As shown at the bottom of Figure A11.1, there are significant differences among the means for both variables. Tukey's HSD indicated that, for both variables, the means for Maths / Numeracy and LOTE are smaller than the means for Science, Literacy, and Studies in Australia (shown in Figure A11.1). However, the sizes of these effects are small (see η^2 in Figure A11.1).

Figure A11.1: Univariate analyses and means for Curriculum Subject Areas



F (4,402)	4.44	4.04
p	.002	.003
η2	.042	.039

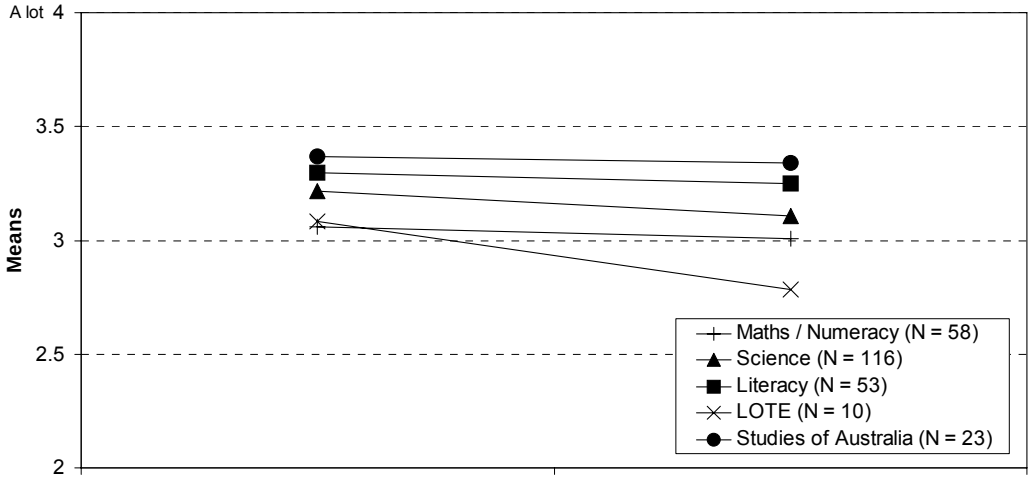
A 1-way between-subjects MANOVA was performed on the two scales (formed in Appendix 9):

- Improvement in learning for class as a whole; and
- Improvement in learning for reluctant learners.

as dependent variables. The independent variable was Curriculum Subject Area.

Using the Wilks' Λ criterion, the combined dependent variable was not significantly related to Curriculum Subject Area (Wilks Λ = 0.95, MV F (8,508) = 2.35, p = 0.152). Strictly speaking, univariate F-tests should not be investigated once a multivariate test has been rejected. Nevertheless, given that these analyses are exploratory, and that there was no sampling design applied for the collection of these data, it is worthwhile to look at univariate tests to see what is suggestive. As shown at the bottom of Figure A11.2, the means for Class as a Whole are not significantly different, but there is a significant difference among the means for Reluctant Learners. Even though the means for Maths / Numeracy and LOTE are less than the means for the other curriculum subject areas (and, for LOTE, more so for reluctant learners), this result can be taken only as suggestive.

Figure A11.2: Univariate tests and means for Curriculum Subject Areas



F (4,255)	1.79	2.11
p	.131	.080
η^2	.027	.032

For both analyses, the means follow the same patterns (namely, the means for Maths / Numeracy and LOTE are less than the means for the other curriculum subject areas. However, it is only for the first analysis (Helpfulness in supporting teaching and learning) is this effect statistically significant.

APPENDIX 12: MANOVAs – HELPFULNESS IN SUPPORTING TEACHING AND LEARNING, AND IMPROVEMENT IN LEARNING BY PRIMARY VS SECONDARY

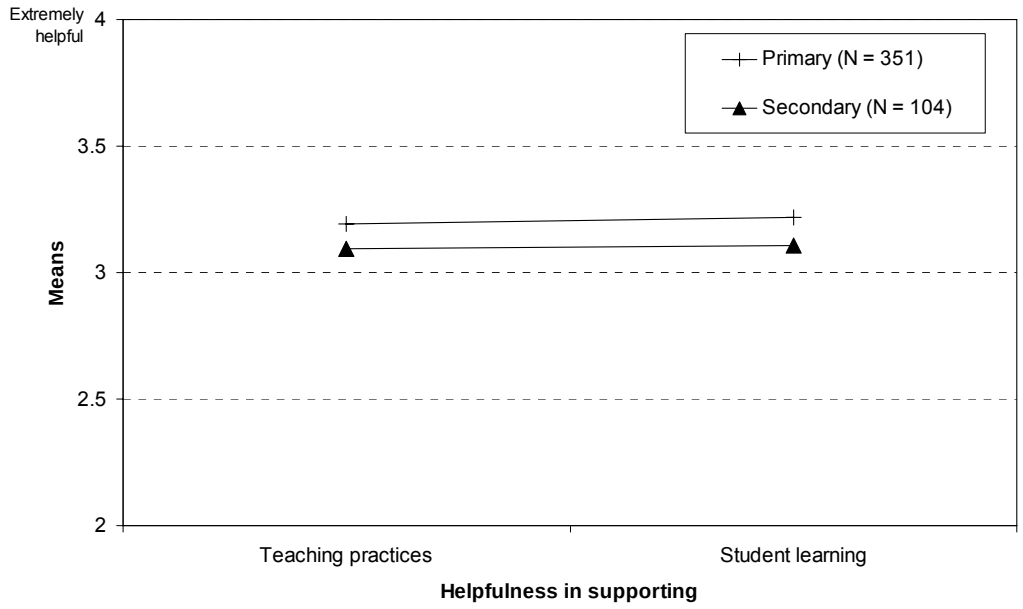
A 1-way between-subjects MANOVA was performed on the two Helpfulness items:

- Helpfulness in supporting teaching practices; and,
- Helpfulness in supporting student learning;

as dependent variables. The independent variable was Level of School (Primary and Secondary).

Using the Wilks' Λ criterion, the combined dependent variable was not significantly related to Level of Schooling (Wilks $\Lambda = 0.99$, MV $F(2,452) = 0.85$, $p = 0.427$). Figure A12.1 shows the means for the Levels of Schooling, and even though there is a slight separation in the means, the means are not significantly different.

Figure A12.1: Means for Levels of Schooling



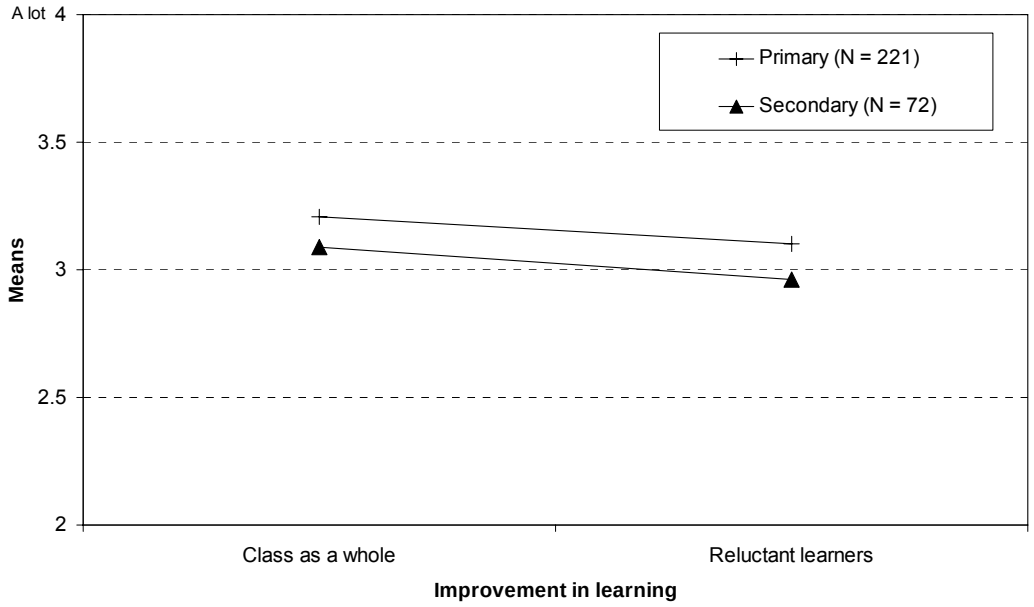
A 1-way between-subjects MANOVA was performed on the two scales (formed in Appendix 9):

- Improvement in learning for class as a whole; and
- Improvement in learning for reluctant learners.

as dependent variables. The independent variable was Level of School (Primary and Secondary).

Using the Wilks' Λ criterion, the combined dependent variable was not significantly related to Level of Schooling (Wilks Λ = 0.99, MV F (2,289) = 1.14, p = 0.323). Figure A12.2 shows the means for the Levels of Schooling, and even though there is a slight separation in the means, the means are not significantly different.

Figure A12.2: Means for Levels of Schooling



For both analyses, the means for Levels of Schooling are not significantly different. That is, for these data, there are no differences between primary school teachers' and secondary school teachers' ratings of helpfulness in support teaching practices, helpfulness in supporting student learning, improvement in learning for the class as whole, and improvement in learning for reluctant learners equally.

APPENDIX 13: MANOVAs – HELPFULNESS IN SUPPORTING TEACHING AND LEARNING, AND IMPROVEMENT IN LEARNING BY CULTURAL, SOCIO-ECONOMIC AND LINGUISTIC CLUSTERS

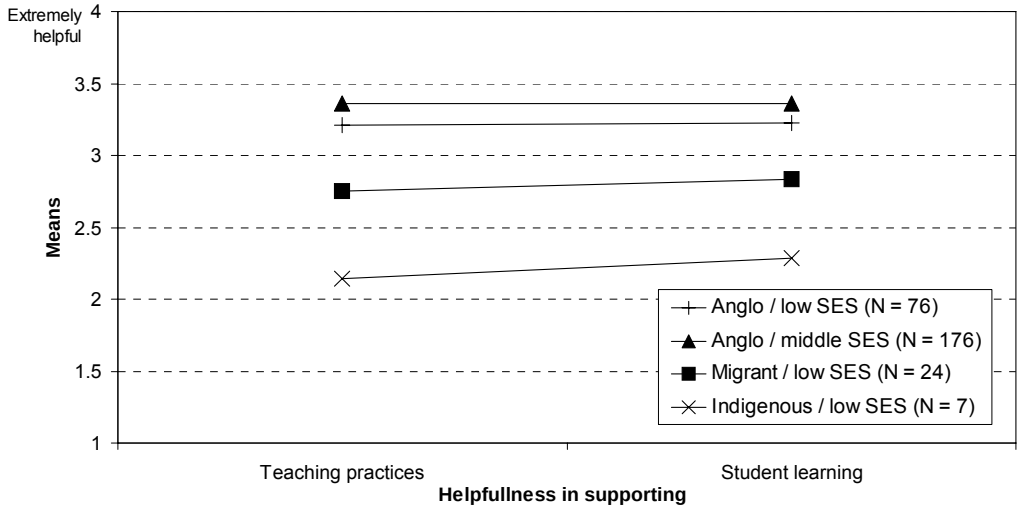
A 1-way between-subjects MANOVA was performed on the two Helpfulness items:

- Helpfulness in supporting teaching practices; and,
- Helpfulness in supporting student learning;

as dependent variables. The independent variable was Cultural, Socio-Economic and Linguistic cluster (Anglo / Low SES; Anglo / Middle SES; Migrant / Low SES; Indigenous / Low SES – formed in Appendix 10).

Using the Wilks' Λ criterion, the combined dependent variable was significantly related to the cultural, socio-economic and linguistic clusters (Wilks $\Lambda = 0.89$, MV $F(6,556) = 5.44$, $p = <0.001$). Univariate F-tests were used to further investigate the effect for Cultural, Socio-Economic and Linguistic cluster. As shown at the bottom of Figure A13.1, there are significant differences among the means for both variables. Tukey's HSD indicated that, for both variables, the means for the Migrant / Low SES cluster and the Indigenous / Low SES cluster are less than the means for the other two clusters (shown in Figure A13.1).

Figure A13.1: Univariate tests and means for Cultural, Socio-Economic and Linguistic clusters



F (3,279)	11.20	8.59
p	<.001	<.001
η^2	.107	.085

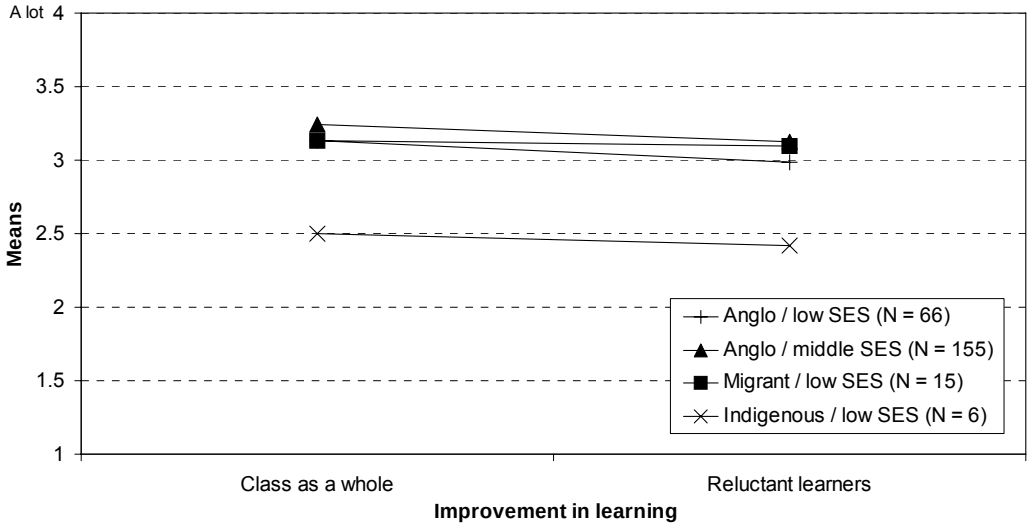
A 1-way between-subjects MANOVA was performed on the two scales (formed in Appendix 9):

- Improvement in learning for class as a whole; and
- Improvement in learning for reluctant learners.

as dependent variables. . The independent variable was Cultural, Socio-Economic and Linguistic cluster.

Using the Wilks' Λ criterion, the combined dependent variable was significantly related to cultural, socio-economic and linguistic clusters (Wilks Λ = 0.96, MV F (6,474) = 1.75, p = 0.107). Univariate F-tests were used to further investigate the effect for Cultural, Socio-Economic and Linguistic cluster. As shown at the bottom of Figure A13.2, there are significant differences among the means for both variables. Tukey's HSD indicated that, for both variables, the means for the Indigenous / Low SES cluster are less than the means for the other three clusters (shown in Figure A13.2).

Figure A13.2: Univariate tests and means for Cultural, Socio-Economic and Linguistic clusters



F (3,238)	3.23	2.39
p	.023	.070
η2	.039	.029

For both analyses, the results suggest that teachers from schools with large indigenous populations are less sure of the helpfulness of the learning objects in supporting teaching and learning, and they give lower ratings for the learning objects' effects of improving in learning. At the same time, it should be noted that these teachers ratings are at or close to the neutral point on the scales (2.5), and that this conclusion is based on the results from a small group (N = 7).